Equine Dental Development and Its Relationship to Disease

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Introduction:
A basic understanding of dental development and anatomy is the foundation for being able to perform a meaningful oral examination, diagnose dental disease and plan and carry out successful treatment. Hypsodont dentition continually changes in number, shape, position, and function throughout the horse’s life. Even though dental procedures have been routinely performed on horses for over 150 years; only recently have we begun to understand in detail the marvel of equine dentition. The use of gross, histological, and ultrastructural examination of the teeth in various aged horses has given veterinarians a better understanding of tooth development and age-related changes. Advanced imaging (CT and MRI) have allowed practitioners and researchers the ability to look at the internal structures of teeth in live horses and pathological specimens. References can be found in the articles cited for additional reading.

Dental Development
Dental development occurs in a series of distinct steps. Tooth formation begins by an invagination of epithelial cells into the jaw ectomesenchyme. The three hard tissues making up the tooth (enamel, dentine and cementum) begin formation and the tooth crown determines its final shape. An extension of the dental lamina of deciduous teeth protrudes and acts as the permanent tooth bud.

A functional periodontium that provides anchorage of the tooth to the alveolar bone cannot develop before the epithelial enamel organ has finished enamel production and disintegrates. At that stage, the cementoblasts come into contact with the completed enamel surface. Cementoblasts start to deposit cementum on the exposed enamel surface and collagen fibers of the periodontal ligament are integrated into this cementum. The periphery of the tooth and the alveolar bone form the 2 borders of the periodontal space which can be visualized radiographically as a radiolucent line, while the alveolar bone appears as a delicate radiodense line termed the lamina dura.

Shedding Deciduous and Erupting Permanent Teeth
The jaws of a newborn foal can accommodate only a few small teeth. Because tooth crown once formed cannot increase in size, the jaws of adult horses require not only more, but larger teeth.
This accommodation is accomplished in horses and most other mammals with two dentitions. The progression from primary to secondary dentition involves the shedding (or exfoliation) of 24 deciduous teeth and the eruption of 36 to 44 permanent teeth. This process occurs between the 1st and 5th years of life, with the deciduous incisor and premolar teeth being shed in the 18 months between 2 1/2 and 4 years of age. The modified Triadan system of numbering teeth will be used throughout these lectures.

The permanent incisors develop lingual and cause resorption of the lingual aspect of the deciduous incisor apex as the eruption force moves the tooth labial. Deciduous premolars erupt from beneath the corresponding deciduous tooth and odotoclastic activity in the tissue between the teeth leads to apical resorption and upward pressure. The erupting permanent tooth leads to exfoliation of the “cap”. The pattern of deciduous tooth eruption and cap shedding along with eruption of the permanent teeth is symmetric for the right and left sides of the mouth. This eruption schedule has been used for centuries to help age horses with fair accuracy. Recent work has shown a tendency for the mandibular teeth to erupt slightly ahead of maxillary teeth. Typically, fillies shed caps about a month later than colts.

Due to the complex nature of tooth formation, jaw growth, and tooth movement into functional occlusion, it is not surprising disturbances in this process occur. Congenital absence of a tooth or teeth may indicate some local or systemic abnormality. Premature loss of a deciduous tooth may lead to early eruption, maleruption, or abnormal development or infection of the permanent tooth. Delayed eruption of teeth is more common and can be related to congenital, local, or systemic factors. Local factors preventing tooth eruption are most common. Early loss of a deciduous tooth, with consequent drifting of adjacent teeth to block the eruption pathway, and eruption cysts are two examples. Crowding of teeth in small jaws often provides little room for eruption, with consequent impaction of teeth. Prominent eruption bumps on the lower jaw are a common finding in 2-5 year old horses due to tooth crown development being ahead of jaw growth and expansion. These bumps are self-limiting in most cases, but may be quite deforming to the facial area and nasal passages of young horses with small, refined heads and disproportionally large teeth.

**Dental Wear and Continual Eruption**

For equine hypsodont teeth to become functional and to remain so throughout life (20-30 years) considerable movement is required to bring them into occlusion and maintain position. The occlusal surface wears from attrition at a rate of 3-7mm per year. Tooth development and movement is complex and has a dramatic impact on dental and oral health.

Tooth movement can be broken down into three phases: pre-eruptive, eruptive, and post-eruptive. Pre-eruptive tooth movement occurs by the deciduous and permanent tooth germs within the tissues of the jaws, before they begin to erupt. Eruptive tooth movement occurs by a tooth to move from its position within the bone of the jaw to its functional position in occlusion.
Bone remodeling of the jaw has been linked to tooth eruption. The periodontal ligament plays a role as does the lengthening of the crown and root formation. In the equid, the tooth crown is mostly developed at the time of eruption but the true roots form slowly over several years and continue to mature throughout the life of the tooth. Post-eruptive tooth movement is responsible for maintaining the position of the erupted tooth. This process is more complicated in the equid than most other domestic species because of the length of the hypsodont tooth crown and its constant occlusal attrition caused by the abrasive nature of silicate in forage.

The horse’s teeth have an occlusal surface that changes from smooth, cement and enamel covered at eruption to one that is worn to the point of exposing the dentine and leaving the sharp columns of enamel layered between soft cementum and dentine. This configuration of tissues allows for a self-sharpening, continually wearing occlusal surface. The hypsodont teeth erupt and the alveolar bone, periodontal ligament, and gingiva are constantly remodeling to keep the tooth in proper occlusion with its opposite counterpart.

Once the horse has all of its permanent dentition (usually at 5-6 years of age) the teeth continue to erupt and move in the jaw throughout the animal’s life. The hypsodont equid tooth will not have a true enamel-free root at its apex at the time of eruption. Roots form over several years and continue to mature throughout the life of the tooth. Hypsodont teeth continue to erupt in response to crown attrition and normally maintain a consistent erupted crown height. The enamel-containing crown of the tooth becomes shorter as the tooth wears. The roots become more prominent over time and the apical opening and pulp horns will narrow. Forces of mastication--both normal and abnormal will affect tooth movement throughout the life of the horse. Normal masticatory forces will cause the teeth to wear in an even manor and slowly drift interproximal, maintaining a tightly packed abrasive surface for forage mastication. The jawbones and periodontal structures are in a constant state of remodeling to accommodate this physiologic tooth movement. Abnormal masticatory forces cause orthodontic tooth movement that can lead to malocclusions and abnormal dental wear.

During the process of eruption and occlusal wear, the pulp horns and chambers of the hypsodont tooth are actively producing secondary dentine to maintain a 5-7mm barrier between the oral cavity and the vital pulp. This process causes changes in the size and conformation of the pulp canals as the tooth ages. The mechanism that leads to the constant production of occlusal secondary dentine is not fully understood, but the forces of mastication probably play a roll. The conformation of the pulp chambers change from occlusal to apical in the reserve crown of the teeth.

Equine cheek teeth have a complex endodontic cavity which is characterized by major age-related changes and individual variation. Up to a dental age (i.e. post eruption age of the tooth) of 2 years, equine cheek teeth have a common pulp chamber in their apical aspect that divides into separate pulp horns towards the occlusal surface, such that each mature cheek tooth eventually has 5-7 pulp horns. When root formation occurs, the pulp cavity becomes completed by the
development of root canals. On the occlusal surface, the dentine overlying each pulp horn appears as a dark brown area (regular secondary dentine) with a bright center (i.e. a focal area of irregular secondary dentine). Thus, the positions of the individual pulp horns are clearly visible. Cheek teeth 07-10 have 5 pulp horns each; the 06s and the lower 11s have 6 pulp horns; and the upper 11s have 7 pulp horns. An endodontic numbering system to aid in the identification of specific pulp horns during clinical examination has been modified and this modified system is now in general use.

The continued production of secondary dentine causes narrowing of the pulp cavities and the common pulp chamber eventually disappears. The pulp system becomes divided into separate pulp compartments. A pulp compartment consists of at least one pulp horn and at least one root canal. With increasing age, this pulp compartment segmentation becomes more and more pronounced. The resulting configuration of individual pulp compartments within one cheek tooth is more complex in maxillary than mandibular cheek teeth. Kopke et al, recently described the age-dependent changes and spatial configuration patterns of cheek teeth pulp compartments.

Similar to brachydont teeth, continued deposition of secondary dentine circumferentially in the pulp horns results in narrowing and eventually filling of the pulp horns in older horses. Equid teeth have deposition of regular secondary, irregular secondary dentine, and even tertiary dentine on the occlusal aspect of the pulp horns to prevent pulpar exposure as the teeth wear. This subocclusal dentine layer does not become thicker with age, as was traditionally believed. In fact, many older teeth have a thinner layer of subocclusal secondary dentine than younger horses. It has also been shown that great variation can occur even in the individual pulps of a single cheek tooth, with some
normal teeth having as little as 3mm subocclusal dentine. This feature is of major clinical significance when teeth are being floated (rasped). While high levels of enamel (inert tissue) overgrowths can be removed, great care must be taken in reducing dentine. The distance of the pulp horn to the rostral (mesial) and caudal (distal) periphery of cheek teeth has been investigated by Bettiol et al. (2011), who showed similar small distances (3-5 mm) between pulp and tooth margin in some teeth, and also great variation for this parameter in others. Knowledge of this feature is of great clinical significance when performing diastema-widening (to treat periodontal disease associated with cheek teeth diastemata) in order to avoid pulp exposure.

The exposure of dentinal odontoblast processes on the occlusal surface is believed to play an important role in regulating the deposition of subocclusal secondary dentine. This hypothesis was recently supported by Marshall et al. (2012). He showed that overgrown cheek teeth often have less secondary dentine than adjacent normal teeth. This indicates that the absence of occlusal stimulus which decreases dentinal deposition, outweighs the increased thickness due to reduced/absence of wear and to the increased eruption present in poorly or unopposed teeth.

Each incisor contains one infundibulum and each functional maxillary cheek tooth (06th to 11th) possesses 2 infundibula—one in its mesial aspect and one in its distal aspect. The cheek teeth infundibula extend almost the entire length of the crown (clinical and reserve crown) and thus can reach a length of up to 100mm in young teeth (Fitzgibbon et al. 2010). The incisor infundibula are considerably shorter extending for only 10–30 mm into the dental crown. Cement filling the incisor infundibulum is usually incomplete.
leaving a large central, infundibular cup. In contrast, maxillary cheek teeth may have a complete cemental filling with a small central opening, which is the site of a former infundibular central artery. This blood vessel provided nourishment for infundibular cementogenesis prior to tooth eruption. When the tooth breaks through the oral mucosa, the central infundibular blood vessels disrupt. Recent studies suggest that the central infundibular blood vessels are supplemented by an apical blood supply that continues for several years post eruption. In addition, blood vessels were demonstrated that enter the infundibula from the mesial side (mesial infundibulum) and from the distal side (distal infundibulum), respectively slightly subocclusally. Hence, infundibular cementogenesis does not cease abruptly when the tooth emerges through the oral mucosa.

The periodontium consists of the alveolar bone, attached gingiva, periodontal ligament and peripheral cementum. The equine periodontium is responsible for continual tooth eruption as well as structural occlusal cementum production. Stazyk and co-workers (2006) have shown the age related changes the take place as the equine tooth matures and erupts.
The Equine veterinarians who practice dentistry should review and understand the process of dental development and eruption. When the concepts are understood and applied, one will readily recognize most of the dental pathology seen in clinical practice.

**Additional Reading:**


Whittle BP. (2016) How to improve your dental practice by better understanding oral anatomy, AAEP Conv. Proceedings 2016 Orlando
Regular Dental Examinations Can Improve the “Health” of Your Practice

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Introduction

Oral-dental examination is the most important aspect of equine dentistry. Oral and dental diseases are common in horses as evidenced by results of incidence studies of dental disease carried out on abattoir specimens. Signs of dental disease are often not apparent to the owner until the disease is well advanced. Casual oral or dental examination as part of a complete physical examination is not sufficient to detect most oral or dental problems. Clinical signs of dental disease are often not specific and may be reflected in other body systems.

Although a comprehensive history and physical examination of every patient seen while performing routine dental work would be a valuable service to clients, this is not practical in most cases. However, one must establish the presence or history of medical problems that may have an impact on safe delivery of dental care. The minimal dental examination process must be thorough enough to detect dental abnormalities/disease in their early stages of development so corrective action can be taken to prevent progression of the pathological process to the point where correction is difficult if not impossible. The extent of the examination will increase depending upon the information obtained in the history and the findings of minimal examination. The examination process must be performed in a routine fashion to ensure efficiency and quality. More information on The Examination: Creating Satisfied Clients and Equine Dental Examination Checklist can be found on the AAEP Website under the TOUCH program.

A complete oral examination includes observing and feeling both oral hard and soft tissues for pathology. The hard tissues consist of teeth and osseous structures. The soft tissues consist of the lips, cheeks, tongue, palate, gingiva, oral mucosa and salivary glands. Variations and/or abnormalities detected at the time of initial examination must be documented. If no notation is made in the record, it can be assumed there were no abnormalities at the time of examination. When routine becomes habit, the results are thorough and the time to complete the examination is reduced. A standard dental record form can be an invaluable aid in developing good examination habits. Computerized dental records make information more available for retrieval and case follow-up. A sample dental record can be downloaded from the AVDC web site under Equine Specialty Documents.
Equipment

The technique for restraint and size of equipment will vary for different ages and sizes of horses. Very large (1000 Kg+) draft breeds need restraint with more heavily constructed equipment than the typical (500 Kg) riding horse. At the other extreme, are the small (100 Kg) pony and miniature breeds. These horses require downsized equipment. Oral examination and dentistry on small horses may also be aided by walking the horse up on an elevated platform to view the oral cavity at a more comfortable height for the operator. Equipment needs include but are not limited to a halter with a large noseband and lead, a metal framed dental halter or headstand, mouth speculum.

A good, very bright light source is necessary for proper oral examination. A clip-on speculum light or head lamp is essential for adequate visualization. Various types of cheek retractors allow better visualization in the buccal spaces. A long-handled, rigid shaft equine dental mirror is useful to visualize the interproximal spaces and occlusal surfaces of the cheek teeth. The strong, rigid handle can be used to retract the soft tissues and visualize hard-to-reach spaces in the oral cavity. Anti-fog treatment with a chemical cloth or wetting the mirror with chlorohexidine solution allows for a more consistent and unobstructed view.

A laparoscope/boroscope with a 30 to 75 degree angled lens is helpful in examining the occlusal surface and between the caudal cheek teeth. A video or still digital camera can be attached to the scope to allow for more relaxed viewing. This method of visualization is an excellent tool for client education. Information on inexpensive equine oral scopes and camera systems are available in the AVDC Forum notes, 2015.

A bucket with diluted disinfectant (chlorhexidine) solution to rinse the horse’s mouth, clean hands, and clean equipment are essential when evaluating the oral cavity. A dose syringe with a blunt tip is useful to rinse the mouth before oral examination and during dental procedures. A high-pressure water irrigation unit can be used to eliminate debris from deep periodontal pockets. Irrigation will greatly aid in proper evaluation of pocket depth and tooth stability. Nitrile gloves should be worn to protect the examiner’s hands and reduce cross contamination between horses.

Dental picks, probes, and forceps are available in various lengths and blade shapes. Sharp, fine picks are used to evaluate occlusal surfaces. Long handled dental probes and right angle fine tipped forceps are helpful in cleaning and evaluating periodontal pockets.
The Dental Examination

A typical examination starts with a brief history while assessing the animal from a distance. The screening process should give the veterinarian a general idea of the type, thriftiness, general use, and overall physical condition of the horse. If any health concerns are noticed, TPR and other physical diagnostic and laboratory tests may be indicated before proceeding with sedation or dental procedures. The animal’s feed and water sources should be observed, noting the amount and type of feed being consumed. Attention should be directed to the horse’s manure to note how well feed is being processed and digested. The head is surveyed for shape, symmetry, and obvious abnormalities. The head should be palpated for irregularities or tender areas especially along the upper dental arcade. The lips are parted, incisors inspected and the age estimated. The oral mucous membranes, intermandibular space, and tongue are evaluated. Range of motion of the jaw is viewed and its grinding sound and vibration evaluated. Some useful information may be gained from evaluating incisor occlusion and separation during lateral jaw excursion. Sedation is often administered at this point in the exam to relax the horse.

The oral examination continues to the interdental space and adjacent structures. This area often reveals the performance horse's bitting history. The lip commissures, bars of the lower jaw, tongue, and palates are evaluated. In male horses over 4 years of age, canine teeth can be observed. The lower canines lay rostral to the upper canines making for a longer lower diastema. The upper canines erupt in the suture between the incisive and maxillary bones and usually break through the mucosa 2 to 8 months after the lowers. Young adult stallions and geldings between the ages of 4 and 6 years may have canine teeth in various stages of eruption. Eruption cysts or tenting of the mucosa with ulceration over these teeth can cause oral pain and bitting problems. It bears repeating, long sharp canine teeth can be a danger to the examiner and care should be exercised to avoid injury when manually examining the mouth. These teeth should not be blunted as this can lead to long-term dental damage. About 25% of mares have one to four rudimentary canine teeth. Dental plaque or tartar accumulation around the lower canines leading to gingivitis is often be seen in older horses.

The upper and lower interdental spaces should be observed and palpated. Firmly run a thumb over the mucosa, feeling for protuberances above or below the gum line and observe the horse’s response to pressure. The lower bars should be checked for sharpness, bony irregularities, mucosal ulcers, or thickenings. The presence of lower first premolars can be detected in horses and should be palpated just rostral to the lower first cheek teeth. The upper diastema is palpated for bony abnormalities and upper first premolars. These caniniform teeth are referred to as ‘wolf teeth’ and erupt between 6 and 18 months of age. If present, they can be found along the edge of the maxillary and palatine bones from the palatal side of each upper PM 2 to 2 to 3cms rostral to this location. These teeth usually erupt through the oral mucosa but can migrate under the mucosa and remain there as bumps. The unerupted wolf teeth, referred to as ‘blind wolf teeth’, can cause oral discomfort and training problems in bitted horses. Wolf teeth come in a vast array of shapes and sizes with the visible crown shape having no relation to the size or shape of the
The distance from the commissures of the lips to the rostral edge of the first cheek teeth should be noted as this varies among horses. This distance will affect the ease with which one works on the rostral teeth and may affect the comfortable position of the bit in a working horse.

The tongue should be checked for function and any anatomical abnormalities noted. Tongues are frequently injured from harsh bits or neglected tongue ties. Calluses or ulcerations are the result of chronic trauma from sharp teeth. Observe and palpate the hard palate. Lampas, or thickening of the palatal mucosa just behind the upper incisors, is common in young horses erupting permanent dentition and shedding deciduous teeth (caps). The hand can be introduced into the interdental space and a thumb pressed on the hard palate to make the horse open its mouth. The oral soft tissues should be observed with special attention paid to the palate, tongue, and buccal mucosa.

Inspect the oral cavity visually and palpate from the labial edges of the incisor teeth, caudal to the buccal recesses distal to the last molar. Subtle details of the examination process are extremely important. The easiest and safest way to thoroughly evaluate the oral cavity is by using a full mouth speculum. Mild sedation is required in most horses to safely and effectively place the speculum and perform a thorough oral examination. To place the McPherson-type speculum in the mouth, the examiner stands to the left side of the horse. With the left hand holding the mouthpiece and the right hand holding the poll strap, the mouthpiece is introduced between the incisors in the same manner as a bit. The left thumb and forefinger are used to open the mouth and guide the mouthpiece into place between the incisors while the right hand applies steady tension to the halter strap from behind the horse’s poll. When the speculum is properly positioned, the left hand is maneuvered to the halter’s buckle to adjust the strap length until the speculum strap is snug. The mouthpiece is adjusted from the front to square it with the incisors. A final check is made to ensure that the teeth and incisor plates are free of tongue, lips, and examiner’s digits so they are not pinched when opening the speculum. It is important to adjust the noseband and chin strap to allow a stable yet comfortable fit on the horse. The jaws of the speculum are opened one notch at a time alternating each side until the jaws are opened two to three notches. If the horse resists its mouth being opened with the speculum in place, the temporomandibular joints and bony structures of the jaw should be carefully evaluated before excessive force is placed on the jaw. At this point, the oral cavity is ready for visualization and palpation. Use a head support stand or metal frame dental halter to elevate the head of a sedated horse to a comfortable height for good visualization and palpation.

To examine the oral cavity, good illumination is critical. Several powerful lights are available. Some of these lights magnetically attach to the incisor plates of a speculum allowing unobstructed viewing of the mouth. A headlight provides good illumination while allowing both hands to be free for instrumentation inside the mouth. A blade retractor fitted with an illuminator will aid in the evaluation of the buccal recesses. A basket retractor designed by Stubbs will keep the tongue and buccal mucosa pulled away from the teeth for good visual access to the last few cheek teeth. Dental mirrors with a long, ridged shaft are useful for
visualizing the occlusal surfaces of the cheek teeth. A flexible fiberoptiscope, rigid laparoscope, or intraoral camera can prove useful in obtaining a close-up and detailed view of the caudal recesses of the mouth.

The teeth should be evaluated for conformation, position, and number. Common premolar findings include hooks, ramps, erupting teeth, or loose caps or cap slivers. In the center of the molar table, one may observe long teeth, wave mouth, cupped out or decayed infundibula, missing teeth, or split or misplaced crowns. The caudal dental arcades should be inspected and buccal ulcers, sharp enamel points or hooks, supernumerary or missing teeth, or ramped dental arcades should be noted. Enamel points that normally form on the buccal and lingual enamel folds or cingula usually do not protrude beyond the level of occlusal surface of the cheek teeth.

The acute angle between the vertical edge of the tooth and the occlusal surface can cause sharp enamel points to look and feel quite prominent. Inspect the mesial and distal dental margins for abnormal tooth contact or feed packed into gingival pockets. A dental probe with a long shaft can be used to probe the four corners of the cheek teeth to detect and clean out periodontal pockets. A calibrated periodontal probe can be used to measure gingival pocket depth, which ranges from 0.5mm to 7mm for normal teeth. It has been shown that gingival pocket depth measurements at the corner of the teeth significantly increase with periodontal disease. Defects in the secondary dentin covering the pulp horns have been found on the occlusal surfaces in some periapically infected teeth. These defects can be detected by scraping the secondary dentine-covered occlusal surfaces of suspect teeth, with a fine dental pick.

The oral cavity should be palpated feeling the buccal, occlusal, and lingual surfaces of all four arcades. The gingival margins of the cheek teeth should be uniform with no feed or forage packed between them. The crown height should be the same on the mesial and distal aspects of each tooth. The crown height should be longer on the buccal aspect of the uppers and the lingual aspects of the lowers. This reflects the normal slope of the molar arcade. Any deviation or asymmetry in molar table height or angle should be noted. Each exposed tooth crown should be grasped between the thumb and forefinger and checked for stability noting any movement. The occlusal surfaces of the arcades should be palpated noting any defects or asymmetry in the occlusal crown surface. Keep in mind that fractured teeth crowns occur in 1-4% of horses examined in clinical practice. Any crown defect in one arcade will usually be reflected in a wear abnormality or defect in the opposite occlusal arcade.
Ancillary Diagnostic Tests

If the initial dental examination findings reveal signs of dental disease, other diagnostic techniques can be employed to make a more definitive diagnosis. A more thorough oral examination can be carried out on a sedated and restrained or anesthetized horse. Endoscopic examination of the nasal passages, larynx, and oral cavity is often indicated. Skull radiographs (plain and contrast film studies) give added information about dental, osseous, and sinus structures. Standing skull films with the mouth open, provide the veterinarian with a more complete assessment of the occlusal pattern of the dental arcade. In many cases, dental disease cannot be diagnosed without radiographs.

Other imaging modalities such as ultrasonography, computerized tomography (CT), nuclear scintigraphy, MRI, or fluoroscopy may reveal a more accurate picture of some dental pathologies. Radiographic examination of the equine skull can add valuable information to physical examination, oral examination, and endoscopic findings. Most equine practitioners have access to portable radiographic equipment making this a routine part of the complete workup of any case with suspected dental pathology. Often, radiography is indicated before major dental corrections can be safely undertaken.

Dental Records, Charting and Treatment Planning

The horse’s signalment, use and management should be recorded. Pertinent history must be noted with special emphasis on digestive system or performance problems. The horse’s general body condition should be recorded and a numbered body score assigned. The results of the masticatory system examination should be recorded and problems listed in order of significance. A plan for treatment of each problem should be outlined based on the results of history, clinical
findings, and oral examination before proceeding with any dental work. This problem-orientated approach is important because the owner and/or trainer should be informed of any abnormalities, given a plan for treatment, and an estimate of the cost before any corrective procedure is carried out. An owner consent statement is often included in record forms and can minimize problems should a legal claim be filed against the veterinarian or a bill come in dispute for collection.

Charting is the process of recording the state of health or disease of the teeth and the oral cavity. To properly chart the mouth, the dental formula and anatomical locations in the mouth must be standardized to make documentation consistent (sample charts on AAEP.com). Use of standard abbreviations for dental terms to describe anatomical boundaries, pathology, diagnostics, and therapeutic procedures has made communication possible between colleagues in both the veterinary and human dental professions (ACVD.org for standard abbreviations and terms).

The American Veterinary Dental College Nomenclature and Classification Committee has endorsed the use of the Triadan tooth numbering system. Numbering is based on a fully phenotypic dentition made up of 44 teeth. This three-digit system uses the first digit to designate the quadrant and arch location and whether the dentition is deciduous (primary) or permanent (adult). The quadrant implies the right or left side of the individual. The arch denotes maxillary or mandibular. The numbering sequences are upper right, upper left, lower left, and lower right. The permanent (adult) dentition utilizes numbers 1 to 4, and the deciduous (primary) dentition uses numbers 5 to 8. In each quadrant, the first or central incisor is always 01, with incisors numbered 01 to 03, the canines, whether present or not, take up the 04 position in the formula. The premolars are numbered 05 to 08 and the molars are numbered 09 to 11.

The Triadan system of equine dental nomenclature for permanent teeth. To identify deciduous teeth, 4 is added to the first number.
Summary

With proper restraining techniques and specific equipment, a thorough dental examination can be performed with minimal stress and risk to the horse and examining veterinarian. A dental record system is important in documenting findings and monitoring case follow-up.

References and Suggested Reading:


Why Do We Float Horses’ Teeth

Jack Easley

Introduction

Historically tools for equine dental care consisted of rasps and molar cutters. The law of the instrument took over equine dentistry for over a century. like Maslow’s Law “I suppose it is tempting, if the only tool you have is a hammer to treat everything as if it were a nail”; equine dentistry was treated as if reducing elongations of the dental crowns was more important part of the job. Diagnosing and treating underlying dental disease was seldom addressed usually because of a poor understanding of equine dental disease and a lack of good diagnostic aids.

Dental corrective procedures that entail some form of crown odontoplasty have been performed on equine patients for hundreds of years. The term ‘dental floating’ as related to equine dentistry denotes the use of rasp, files, or burrs to perform odontoplasty of sharp points contained on the buccal portion of the upper row of cheek teeth and the lingual side of the lower row of cheek teeth. These sharp areas are thought to traumatize the mucosa of the cheeks and tongue. Performed on a regular basis, odontoplasty corrective procedures have traditionally been part of a horse’s health care program, with very little scientific evidence to support this practice. Odontoplasty procedures are often performed by veterinarians in an attempt to: 1) relieve discomfort associated with oral soft tissue injuries caused by sharp enamel points, 2) reduce dental elongations which place abnormal stress on affected teeth, jaws, and temporomandibular joints thus improving occlusion, 3) improve mastication and digestion of feedstuffs, 4) alleviate stresses and reduce attrition to abnormally worn teeth, and 5) prevent discomfort and improve performance in the horse wearing a bit and bridle. 1-10

Historically, equine dentistry has involved numerous procedures including oral examination, and reduction of sharp enamel points. In addition to sharp enamel points, the veterinarian may identify other elongations of the clinical crown involving the hypsodont cheek teeth or incisors. These elongations can place abnormal stress on the affected tooth or teeth and may involve a portion of a tooth (hooks, abnormal transverse ridges), the entire tooth (step, ramp), several teeth (wave), or the entire arcade (shear). Stress forces resulting from overlong teeth can cause the teeth to shift and ultimately lead to rostral or caudal displacement, linguoverison, or buccoverison. The resulting diastema caused from tooth displacement can lead to periodontal disease. It is important to remember that the true pathology associated with elongated teeth in horses often involves a jaw or tooth malocclusion or developmental or acquired pathology to the tooth/teeth and periodontal tissue opposite the elongated dental area. Failure to evaluate and properly address the underlying pathological process may lead to recurrence of elongations and a temporary or unsatisfactory result for the patient. The aim of dental care for the equine patient is to alleviate pain and preserve the function of the teeth. It is very important for the veterinarian to remember to strive to do no harm to the horse or its teeth when performing odontoplasty procedures.
Clinically, horses which have good proximal contacts between the molar and premolar teeth, and an even pattern of occlusal attrition, are less likely to have periodontal disease, and similarly with the incisor teeth. With good functional occlusion, good dietary management, appropriate bitting, good riding habits, and good general health, there should be no need for odontoplasty as part of the management of oral health.

The dynamic nature of the equine hypsodont tooth provides the observant clinician with more information about endodontic health and occlusal status than can be easily gained from observing brachydont dentition. Once the tooth comes into full occlusion, it is not long before the occlusal topography of the molariform teeth reflects both occlusion and pattern of mastication. The pattern of mastication may be influenced by feed substrate, dental pain, musculoskeletal pain, and occlusion.10 Due to the rostro-caudal shift in mandibular-maxillary relation which is dependent on head position (for example, grazing versus resting), the head position at which most mastication occurs may also influence occlusal topography. While dental stone models and bite registrations are helpful in assessing brachydont occlusion, much can already be determined from observing the pattern of attrition in equids. However, it is important to note that regular generalized odontoplasty is likely to make interpretation of occlusion more difficult (Mesowear patterns).

Occlusion may be influenced by dental factors. Supernumerary teeth, missing teeth, fractured teeth, dysplastic teeth, rotated teeth, persistent deciduous teeth, senile teeth, and tooth size may all affect occlusion. Tooth size is most resistant to genetic change. As a result of breeding selection for small skeletal size, the smallest horse and pony breeds have relatively large teeth, resulting in increased incidence of developmental dental problems. Diseases affecting the supporting structures of teeth, such periodontal disease, Cushings disease, and equine odontoclastic tooth resorption and hypercementosis (EORTH), may also secondarily affect occlusion.

Functional malocclusions may develop as a result of a changed masticatory pattern. The equid may change the pattern of mastication to avoid oral pain, for example dental pain, periodontal pain or orthopedic pain, or in response to substrate characteristics, such as pelleted food.10 Temporomandibular disease in the equid is rare, and usually associated with trauma. Along with other rare diseases, for example a retrobulbar abscess, these conditions may alter the normal path of the mandibular ramus, either physically or due to pain or both and may also result in a functional malocclusion.

A Class 1 Malocclusion (neutroclusion) 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. While 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.12
A malpositioned tooth, in the horse with normal jaw lengths, is another type of Class 1 Malocclusion. Rotations, 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, while 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. 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. Normal cheek tooth occlusion is often observed with these incisor malocclusions. 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 1st cheek teeth (306, 406).

Malocclusions in the equid often result in secondary effects, such as soft tissue interference, diastema formation, feed enlargement to some or all of the masticatory muscles initially through inflammation alone, but later also through hyperplasia; it may also lead to disuse atrophy of some masticatory muscles. Clinically, a common effect of masseter muscle enlargement is medial displacement of the buccal mucosa increasing soft tissue interference predominantly with the maxillary molar teeth. At the occlusal level, the cingula (from mesial to distal: parastyle, mesostyle, and metastyle) create pressure points in the buccal mucosa. How the buccal mucosa responds varies depending on severity of insult, time, and other pre-existing conditions (such as Cushings disease which affects among other things, collagen synthesis and immune function). If the integrity of the mucosa is not overwhelmed, a reactive/protective response such as hyperkeratosis results. If the integrity of the mucosa is overwhelmed, tissue necrosis occurs resulting in ulceration of the mucosal and submucosal layers. Recognizing which process is present is important for diagnostic, prognostic, and treatment reasons.

If the primary cause can be treated or managed, then many of the secondary and tertiary problems may self-correct. The resolve of secondary and tertiary problems can be a good indicator that the primary cause has been correctly diagnosed and treated. Initially, symptomatic treatment, such as analgesia, may also be indicated. Where treatment of a malocclusion is indicated, selective odontoplasty may be used to alter occlusal forces. Management of the malocclusion may also include changes in diet, feeding regimes, bitting and other tack, riding/driving habits, and on-going management of occlusal forces. Malocclusions of the molariform teeth more commonly require treatment compared to the incisor teeth.

The type of orthodontics described in this paper may best fall in the category of interceptive orthodontics. Interceptive orthodontics is performed during the formative and eruptive period of dentition. Due to the extended period of eruption of the equid hypsodont tooth, this period extends for most of the animal’s life. Classical orthodontics use devices/appliances to apply forces to the crown and then retain them in their new position to prevent relapse. Appliances may be active or passive, fixed or removable, and provide continuous or intermittent forces. Orthodontic forces have been categorized into intrusive, extrusive, tipping, rotational, and
translational. Movement of a tooth employs more than one type of force – restriction to one type of force is not regarded as clinically possible. The orthodontic forces described hereon utilize the occlusal forces provided during mastication with the predominant type of orthodontic force generated usually being tipping. The occlusal forces of mastication can be reduced on a portion of the occlusal surface to effect orthodontic movement. The process appears a slower one compared to orthodontics affected with a device in humans and small animals. However, no retainer period is necessary. It is also likely to be a more physiologic than pathologic process, but further investigation is required. Risks associated with human orthodontic treatments include: enamel damage, root resorption, periodontal damage, temporomandibular disorders, tooth devitalization, treatment failure, and relapse. Of these, treatment failure and relapse are the most likely risks in clinical equid cases utilizing the described process. Utilizing occlusal forces to move teeth is not well covered in the literature. It has been suggested as a possible method to address teeth, which undergo pathological tooth movement in humans. Another area of the literature which touches on the subject, is the removal of occlusal interferences during the post-orthodontic movement retention period to try and prevent relapse.12

**General Approach to Occlusal Adjustment Procedures**

Two approaches to performing dental corrective procedures have become standard over the past few years. Both involve examination and dental corrections carried out in a standing, sedated equine patient. In rare cases, general anesthesia may be required to thoroughly examine and treat dental problems. The less involved type of standing restraint has been described as ‘performing dentistry by feel’ (non-visual). This type of dentistry is performed with the horse’s head at the level of the operator’s waist or chest. This requires minimal sedation and works well for most horses with relatively normal dental occlusion needing only odontoplasty of sharp points of the cheek teeth. The horse’s head can be periodically elevated and the oral cavity visually evaluated during the procedure.11-14 The second method commonly employed is ‘visual dentistry’.15 Working in the horse’s mouth visually requires the patient to be well restrained and more heavily sedated. The animal’s head must be elevated and supported at a height that allows visualization of the mouth while the veterinarian maintains a comfortable ergonomic body position.16 Visual dentistry allows for a more thorough dental examination and precise correction of dental abnormalities. Both methods have their place in practice but visual dentistry has many advantages over dentistry by feel, especially in horses with severe wear abnormalities or other dental pathology. Working with dental instruments, including power equipment, requires strength, dexterity, and mastery of technique. The visual method allows better access to the mouth and lowers the learning curve on the use of equipment. Dental corrective procedures such as floating teeth were once considered fairly innocuous. With the development of better quality and more efficient equipment to perform odontoplasty procedures, dental correction can be overdone and have severe detrimental effects on the patient.13 Rasping teeth has been shown to amputate odontoblast processes, leave deep grooves in the surface of the dentin and/or chip the enamel surface and peripheral cement. Motorized dental tools can remove large amounts of dental tissue and create heat; this increases the risk of thermal damage to the odontoblasts contained in the pulp horns. It has recently been speculated
that horses may suffer dental pain after corrective procedures. A fine-toothed burr or dental rasp used with light intermittent cutting strokes causes less damage in reduction. An efficient water cooling system and frequently cleaning the burrs may reduce the chance of thermal injury to the dentin and pulp.

**Odontoplasty of Sharp Dental Points**

In veterinary medicine the concept of prophylaxis, that is, the ability to use a practice that will prevent the development of subsequent serious disease, is the foundation of any health maintenance program. Dental prophylaxis or prevention (i.e. the examination of the oral cavity and the use of corrective procedures to arrest disease processes before clinical signs are seen), has been reaffirmed as an important part of a patient’s health care program. In equine veterinary practice, dental prophylaxis involves the use of files and burrs to perform odontoplasty of sharp points on the buccal aspects of the upper and lingual edges of the lower cheek teeth in order to provide more comfortable mastication and bitting for the horse. Floating may be the initial dental procedure performed in order to make the mouth more comfortable when using a full mouth speculum to perform the oral examination and other dental procedures. Hand floating by feel with minimal sedation has been well described. Many practitioners use power tools in routine floating. Since each type of motorized dental equipment requires varied techniques, it is recommended that one work closely with practitioners who have experience with the specific instruments being used. Manufacturer recommendations on the use of particular power driven instruments should be followed very closely. Equine dental floating should be approached in a sequential fashion. A full set of hand floating instruments is needed to reach the various areas of the mouth.

**Indirect Evaluation of Cheek Teeth Occlusion**

With the speculum removed, the veterinarian evaluates the movement of the mandible in the sedated horse in order to assess components of the horse’s chewing apparatus. A simple method of assessing cheek teeth occlusion involves raising and supporting the horse’s head, then sliding the mandible to the left and right while retracting the ipsilateral cheek for viewing. As the examiner slides the mandible laterally, the lower row of cheek teeth normally comes in contact with the upper row of cheek teeth. Using this technique the veterinarian can feel and/or visualize areas that may interfere with mastication (i.e., an overlong tooth or protuberance). If necessary, the speculum is reinserted and additional odontoplasty is carried out, followed by re-evaluation of cheek teeth occlusion to ensure the procedure has been successful. In some instances, radiographic examination of the area may be indicated before additional odontoplasty procedures. Rucker determined a method to evaluate cheek teeth occlusion by measuring the distance that the mandible can be slid to the left or right until the cheek teeth come into occlusion (‘Excursion to Molar Contact Distance, or EMC distance’). Measurement of EMC distance has been used in calculations involving masticatory function.

If there is excessive excursion to molar contact, then conservative incisor crown reduction can be performed. Some diagonal incisor malocclusions have recently been shown to have accompanying deformation of the incisive bone. 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.

**Summary**

Dental examination and dental prophylaxis performed on a regular basis are procedures that are advocated by veterinarians as important components of an overall horse health care program. Careful and complete oral examination is critical in the diagnosis of dental pathology and the planning of dental corrective procedures. It is important for veterinarian to be knowledgeable and possess the proper equipment to facilitate the examination and procedures. This should include a bright light source, head support apparatus, and dental speculum. The patient should receive adequate analgesia/sedation in order to reduce the occurrence of undesirable or difficult behavior during the procedures. The veterinarian should remember to keep observers at a safe distance while work is performed. High quality manual instruments and motorized dental floats are readily available for managing sharp dental points and dental elongations. An important concept to keep in mind when addressing abnormalities of occlusion of the dental arcades is to perform procedures that will allow normal mastication.

References and Suggested Reading


Every Veterinarian Can Take Good Dental Radiographs

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Introduction

For years, equine surgeons have found equine skull radiography to be a valuable tool in the diagnosis and management of dental disease. The excellent contrast between air, bone, soft tissue, and tooth substance make the head an ideal area for radiographic evaluation. Conventional or standard radiographic projections adequately image the reserve crown apices, lamina dura denta, alveolar space, and alveolar bones as well as changes in the associated maxillary, mandible, and sinonasal structures. With these conventional closed-mouth radiographic projections; the erupted crown is obscured by superimposition of the crowns of the opposite dental arcades. Until recently, radiography has been of limited value in the assessments of lesions involving the gingival margins or evaluation of the exposed tooth crown. With the recent introduction of open mouth oblique radiographic views and digital and computer radiography, a more accurate diagnosis of lesions affecting the clinical crowns of the check teeth can be made.

Several factors may limit the practitioner from acquiring good quality films (i.e., size of the horse, types of intensifying screens, and films and exposure capabilities of the portable x-ray machine). Some limitations can be overcome by reducing movement of the horse’s head and appropriate positioning of the x-ray cassette and x-ray machine while taking the radiography. The differences in tissue density and the increasing width of the horse’s head from rostral to caudal may require more than one radiographic exposure of the anatomical area to highlight the tissues to be evaluated. With DR and CR, the computer algorithms in the radiographic system can be adjusted to compensate for most variations in tissue thickness. A recent paper by Baratt has been published in the 2016 AAEP Proceedings (2016) on how to improve diagnostic quality of dental radiographs.

In order to generate the required image, knowledge of skull anatomy and topographic landmarks is necessary to insure correct positioning of the x-ray unit, cassettes, and horse’s head. The head is anatomically complex and the use of large cassettes -14”x 17” (34cm x 48cm) – helps maintain spatial relationships when evaluating the radiograph. Coning down on the radiograph will allow better contrast and detail over a smaller area of greater concern. It is helpful to use both right and left projections in order to take advantage of image sharpness and magnification in the location of interest. Because of age related changes in the hypsodont teeth of the horse, it is beneficial at times to take lesion-orientated oblique views of the infected area and the opposite (normal) side of the skull to have a comparison film to evaluate.
Good quality radiographs can be taken with a high-frequency portable x-ray unit capable of generating 80KVp and 15 MA. Medium or regular speed rare earth cassettes with fast speed film without a grid can be used with a focal film distance of 80-100cm. Most of the DR and CR systems on the equine market are well suited to head and dental radiography. A table or headstand with a flat surface (approximately 100cm off the ground) is used to support the sedated horse’s head. Smaller cassettes are used for lesion oriented oblique films. Wooden or foam blocks are used to position the head and x-ray cassettes. These blocks are also used to support smaller cassettes and to elevate the cassettes to the height of the cheek teeth arcade. Bungee cords are useful to hold cassettes in position. A blindfold or towel placed over the horse’s eyes aids in restraint and helps avoid motion artifacts. Three different 10 cm long sections of PVC pipe can be used as mouth gags. A 7.5 cm diameter section of pipe is used on smaller horses and ponies. This diameter equates to 2 clicks on the standard McPherson mouth speculum. Sections of 9cm diameter and 11.5 cm diameter PVC pipe are used to wedge the mouth open in larger horses. Two sections of 3 meter long x 0.5cm diameter cotton or nylon rope are used to steady the horse’s head and/or put traction on the mandible. A cassette holder and suitable radiation protection equipment consisting of gloves, apron, and thyroid guards are used when taking the x-rays.

Heavy sedation of the horse is necessary both to safely obtain skull radiographs and to facilitate separation of the maxillae and hemi-mandibles. A combination of xylazine hydrochloride @ .3-.6 mg/kg or detomidine hydrochloride @ 10-20mcg/Kg with butorphanol tartrate 10mcg/Kg provides 20-30 minutes of heavy sedation. This allows time for a comfortable and detailed oral examination and relaxed, motionless radiographs with the horse resting its muzzle on the table or headstand.

Radiography is often times the only imaging modality available and frequently yields an immediate diagnosis. On the other hand, further advanced imaging may be required in patients that are recalcitrant to medical therapy, require extensive surgical intervention, or have a disease that involves more than one tooth. As a general practitioner, it is important to understand the limitations of radiography to clearly diagnose equine dental disease. Advanced imaging may be employed to better characterize the extent and exact location of the abnormality, thus allowing a more effective treatment.

When deciding whether to perform advanced imaging in dental cases, it is important to realize that CT and MR do not guarantee a precise diagnosis. On the other hand, it is also important to realize that advanced imaging is acceptable to perform even on cases where a confident diagnosis has been made through other modalities.

**DENTAL RADIOGRAPHS VIEWS AND TECHNIQUE**

**Lateral Radiographs**
This view is obtained with the cassette positioned in a vertical plane, as close as possible to the affected side of the head. The rostral aspect of the facial crest is approximately the center of the cheek tooth rows in most horses, and the horizontal x-ray beam should therefore be centered at this point. This view is easy to obtain and is useful for assessment of the paranasal sinuses for fluid lines, which may be caused by empyema due to apical infection of the 3rd to 6th maxillary cheek teeth. The main disadvantage of this view is that the apices of the left and right cheek teeth are superimposed and it is therefore not possible to evaluate individual apices for radiographic changes.

30-45 degree Dorsolateral-lateral Oblique Radiographs (maxillary check teeth apices)

This oblique radiographic view separates the left and right maxillary check teeth rows, allowing evaluation if individual apices and the surrounding maxilla. The cassette is again positioned in a vertical plane, as close as possible to the affected side of the head. The x-ray tube is positioned at a higher level on the opposite side, with the beam directed 30 degrees down from the horizontal and centered at the rostral aspect of the facial crest. The additional presence of rostro-caudal angulation is a common technical fault associated with this projection and should be avoided.

45-60 degree ventrolateral-lateral oblique radiographs (mandibular check teeth apices)

This oblique radiographic view separates the left and right mandibular cheek teeth rows, allowing evaluation of individual apices and the surrounding mandible. For this projection, the cassette is again positioned vertically as close as possible to the affected side. The x-ray tube is positioned at a lower level on the opposite side, and the beam directed 45-60 degrees up from the horizontal, centered on the affected tooth. Although increasing the angle gives greater separation of the left and right check teeth rows, increasing distortion of the apices also occurs, making dental evaluation more difficult. A larger angle is required to separate the check rows in smaller heads where the inter-mandibular distance is short. The thick masseter and pterygoid muscles overlay the caudal 2-3 check teeth and some degree of caudal obliquity and increased exposure is usually required to image these apices, as compared to the rostral 3-4 check teeth.
Dorso-ventral Radiographs

This radiographic view is obtained by positioning the cassette underneath and parallel to the hemi-mandibles (the horse’s head can be ‘rested’ on the cassette). The x-ray beam is directed perpendicular to the plate, centered in the midline, at the level of the rostra aspect of the facial crest. Positioning is very important when taking this radiographic view because any lateral distortion from a true DV will cause superimposition of the mandibular and maxillary arcades on one side. This view is most useful for evaluating the areas of the ventral conchal sinus (medial compartment of the rostral maxillary sinus), nasal cavity, and nasal septum. Laterally or medially displaced teeth can also be observed from this view, sagittal fractures, and advanced caries of the maxillary cheek teeth can also be detected. The mandibular cheek teeth are not as easily evaluated from this view because the dense cortical bone of the hemi-mandibles overlies their lateral aspects. Transverse fractures of the mandible and occasionally maxillary bone fractures may also be observed with this view. The lower jaw can be displaced to one side with the mouth open allowing unobstructed viewing of the first 4 upper cheek teeth.

Open-mouthed Oblique Radiographs (15 degrees ventrolateral-lateral for maxillary erupted crowns, 10-15 degree dorsolateral-lateral for mandibular erupted crowns)

These radiographic projections are useful for evaluating the erupted (clinical) crown of the cheek teeth, which are usually not visible on conventional views due to superimposition of the opposing arcade. A Butler’s gag or hollow PVC pipe is placed between the incisors of the
sedated patient to separate the maxillary and mandibular erupted crowns. The direction of the x-ray beam is the opposite of that used for conventional (closed mouth) views and the angle of incidence of the beam is also reduced (i.e., 10-15 degrees). Disorders such as coronal fractures, diastemata and disorders of wear can be well evaluated using these projections.

Intra-oral Occlusal Radiographs of Incisor Teeth:

These projections are useful for evaluating the incisors and canines. A small cassette or non-screened film is placed between the incisors and canines, as far caudally as possible, and the x-ray beam is directed at 60-80 degrees in order to include the reserve crown and apices of the incisors.
Intra-oral Radiographs of the Check Teeth

This modified Gibbs technique utilizes a flexible 4”x 8” cassette and a bisecting angle technique that was perfected by Dr. David Klugh. It provides evaluation of a single tooth from crown to apex. The horse is sedated and a full mouth speculum is used to hold the mouth open. The flexible cassette and film are introduced into the mouth and placed against the teeth to be evaluated. The x-ray beam is directed at a bisecting angle to the teeth and cassette to minimize image distortion. High quality images of several teeth in a single arcade can be obtained with this technique without superimposition of the opposite arcade.

Additional Radiographic Techniques

The use of a small metal marker (e.g., paper clip or skin staple) placed over an area of maximal facial swelling can be useful when evaluating radiographic changes suspected to involve the cheek teeth apices, and to assess their likely significance. If an external sinus tract is present, a blunt, malleable metallic probe should be inserted into the tract and the appropriate lateral oblique radiograph taken. This procedure can provide irrefutable evidence of dental disease, identify the affected apical area of the tooth and provide a landmark for placement and angulation of the dental punch if tooth repulsion is to be performed. Lateral oblique radiographs often have a degree of rostro-caudal distortion; the horse lowering its head when sedated can cause this. Consequently, if the relationship of the angle of the probe to the angle of the tooth is
not clear, a true lateral projection should also be obtained with the probe in situ. The injection of contrast material (e.g., Iohexol (Omnipaque)) into a draining tract can similarly provide valuable diagnostic and spatial information.

Radiography of canine and wolf teeth is particularly useful if these structures are unerupted, displaced and/or abnormally angulated, or to provide information to the surgeon prior to attempting extraction. These views should be taken with the affected side next to the cassette and the x-ray beam angled at 10-15 degrees dorsolateral-lateral (to view the maxillary teeth) in order to separate the teeth on the right and left sides.

Normal Appearance and Age-related Variation in Radiographic Appearance

The radiographic appearance of the equine cheek teeth, and particularly their apices, varies markedly with age and an appreciation of the normal variations is required in order to enable proper interpretation of dental radiographs. Most apical infections occur in young horses when there can be marked differences in the appearance of the apical areas of the different cheek teeth. Although radiograph is a very specific diagnostic aid (95% specificity), it is not very sensitive (50% sensitivity), (Gibbs and Lane, 1987 and Weller et al, 2001). Therefore, in early cases of periapical cheek tooth infection, even experienced clinicians may not be able to definitively identify lesions.

Enamel is the densest material in the body. Therefore, the cheek teeth appear as strongly radiodense structures, within which the more radiolucent pulp cavities may be seen running longitudinally. The reserve crown of the cheek tooth is attached to the alveolar bone by the periodontal ligament. The periodontal ligament is evident radiographically as a narrow parallel radiodense rim of cortical bone, the lamina dura denta, which lines the alveolus. Although disruption of this structure is a sign of dental disease, the irregular contour of equine cheek teeth often hides the lamina dura denta of normal teeth. The area of the periodontal ligament may widen due to disease processes, but young horses with eruption cysts may also have slightly wider radiolucent areas adjacent to the lamina dura denta in the area of the eruption cysts.

Foals are born with 3 deciduous teeth in each row and these may by identified by their short, spickled roots. The dental sacs in the young horses are large, rounded radiolucent structures with a striated pattern which is due to partially calcified enamel formation. As the dental sacs develop into cheek teeth, their apical areas appear as round, radiolucent areas with a wide periodontal space (eruption cysts). The lamina dura denta is often not visible in the apices of the developing teeth. As the horse ages and the cheek teeth erupt, the true roots (i.e., enamel-free areas) develop and the apices change from rounded to pointed. Bearing in mind that the equine cheek teeth erupt between 1 and 4 years of age, it is a normal feature of young horses to have cheek teeth with variably appearing apical areas. For example, major differences are present between the apices of the third and fourth cheek teeth in a 4 year old, because the 4th cheek tooth is 3 years older than the 3rd. Consequently, caution must be exercised when comparing the radiographic appearances of adjacent cheek teeth apices in younger horses.
Radiographic Signs of Dental Disease

Early periapical infection of the cheek teeth causes the periodontal space to widen and the lamina dura denta becomes thin or disappears. When periapical infection has been present for many weeks, the infected apices develop lytic changes, especially in mature teeth where the roots are well formed.

These manifest as periapical radiolucent ‘halos’ and the rounded or ‘clubbed’ appearance of the tooth roots are due to gross lyses and destruction of the root structures. In more chronic periapical infections, a zone of radiodense sclerosis usually surrounds the periapical ‘halo’. This is due to new bone deposition around the lytic infected area.

More marked sclerosis develops around the apices of all the mandibular and the first 3 maxillary cheek teeth than the caudal maxillary cheek teeth. This is because the mandibular and the first 3 maxillary cheek teeth are positioned in more dense bone than the caudal maxillary cheek teeth, which are situated in thin alveolar bone within the maxillary sinuses. External draining tracts are common with periapical infections of mandibular cheek teeth infections. Occasionally, external draining tracts will occur with rostral maxillary cheek teeth infections. Infections of the caudal maxillary cheek teeth rarely present with an external draining tract unless the teeth are laterally
displaced. Soft tissue densities may be apparent in the sinuses if periapical infection of the caudal 3-4 maxillary cheek teeth has occurred (see dental sinusitis section).

In early cases of dental disease, scintigraphy (which provides a functional image of bone) is proving a useful adjunctive tool to radiography, being highly sensitive (95%), but of moderate specificity (86%) (Weller et al, 2001). Because of the major short and long-term consequences of extracting the wrong cheek tooth, it is better to take a conservative approach in such cases if scintigraphy is not available, or if the combined results of these two imaging modalities are unclear. If there is any doubt as to whether a tooth needs to be removed, it is better to err on the side of caution by treating suspected dental infection with systemic antibiotics and re-evaluating radiographically in 4-6 weeks, where changes may have become more marked.

References and Suggested Reading:


Periodontal disease (PD) is an altered state of the periodontium. The periodontium is the attachment apparatus of the tooth consisting of the gingiva, alveolar bone, periodontal ligament (PDL), and the cementum. It is responsible for hypsodontic tooth eruption and for the distribution of masticatory forces from the teeth into the supporting bone. PD is an inflammatory process consisting of cyclic intervals of active destruction (periodontitis) and inactive quiescence. These repetitive cycles of disease cause progressive attachment loss resulting in increased tooth mobility and eventually premature exfoliation of the tooth. The predisposing feature to periodontitis in horses is food sequestration in the gingival sulcus, which is usually predisposed by inappropriate interproximal spaces between teeth (diastemata). Periodontal disease is the primary cause of tooth loss in mammals, and was found to be the reason for extraction of 70% of equine cheek teeth in primary practice.

A degenerative syndrome of the incisors and canine teeth has been labeled “incisor periodontitis”. A large survey of 800 donkeys showed an incidence of PD of 13% involving the incisor teeth. Calculus and chemical or mechanical irritation was responsible for 75% of the mild PD incisor cases. Incisor diastemata and trapped food were the predisposing factor to 19% of the cases.

Recent work by Staszyk and others has demonstrated with radiography, (high definition micro CT and histologically) that the principle pathology of this disorder is tooth resorption and hypercementosis (EOTRH). This disease will be covered in more detail in the Geriatric Dental talk that accompanies this lecture series. Lower canine teeth often are covered with plaque or calculus, which predisposes to gingivitis and periodontal disease. This is easily diagnosed from a clinical examination but the extent of disease cannot be evaluated until after the affected tooth has been cleaned and scaled. The canines can also be associated with EORTH.

Periodontal disease is a syndrome, which is comprised of gingivitis, periodontitis, reduced peripheral cementum production, alveolar bone recession, and peripheral subgingival caries. It is frequently accompanied by moderate to severe oral pain, which can result in inability to masticate food effectively and cause significant loss of body condition. The extraoral clinical signs associated with PD are similar to those of other dental diseases and are usually indicative of advanced disease. Weight loss, dysmastication, oral dysphagia (quidding), selective appetite, halitosis, hypersalivation, facial enlargements in the buccal area, purulent nasal discharge, biting problems, and behavioral changes have been reported. Since all tissues of the periodontium are innervated, PD is associated with pain. Horses may object to manipulation of the head, mouth, or teeth. Oral signs of PD include:

- feed trapped in diastema between teeth
- accumulation of plaque, calculus, debris, or exudate around the tooth
- gingival inflammation, edema, recession or hypertrophy
- sulcular hemorrhage during examination or odontoplasty
• periodontal pocket or diastema formation
• tooth mobility, migration, or extrusion, and eventual tooth loss.

The condition of each tissue of the periodontium visualized should be characterized. Standardized periodontal indices (plaque, calculus, sulcular bleeding, and gingival indices) are widely accepted in both human and veterinary dentistry and can be used to simplify the documentation of the visual examination. Observation of the extent of pathology can be greatly enhanced using oral endoscopy, which facilitates measurement of the depth of the periodontal pocket with a calibrated periodontal probe. Radiography is helpful in confirming the depth and width of attachment loss and associated pathology.

Tooth mobility is a reliable, positive predictive diagnostic and prognostic indicator. Increased mobility proportionally associates with advancing PD and chances of tooth loss. However, lack of mobility does not always correlate with the lack of or early stage PD. Affected teeth should be manipulated to determine mobility. Tooth movement of 1-2mm is considered normal in geriatric patients, but movement greater than 3mm almost always indicates advanced, untreatable PD.

**Endodontic disease** is defined as an infection involving the pulp usually associated with the dental apex or root and surrounding bone. In the horse, this type of disease has several synonyms: apical osteitis, apical periodontitis, periapical abscess, dento-alveolar infection. This type of dental disease is typically seen in young horses with the median age 5-7 years. Early and
accurate identification of endodontic disease prior to osseous fistula and secondary effects on the surrounding tissues seldom occurs, but should be diagnostic goals.

The most common clinical presentation associated with infection of the rostral two or three maxillary cheek teeth (06s-07s-08s) is a rostral maxillary swelling with a cutaneous sinus tract or less commonly, ipsilateral nasal discharging tract. Infection involving the upper 06s and 07s has been associated with purulent discharge from the ipsilateral nasolacrimal duct. A foul smelling, unilateral nasal discharge associated with sinusitis can be seen with apical infection of the caudal three or four maxillary cheek teeth (08s-09s-10s-11s). Involvement of the infraorbital canal has been associated with apical infection of the upper 08s and 09s. Mandibular enlargement with a sinus tract is seen with apical infections involving the first four lower cheek teeth. The caudal two lower molars (10s-11s) usually cause enlargement and drainage under the muscles of mastication.

The proper tooth must be identified and this can be confusing at times, especially when no obvious oral signs or symptoms are present. Oral signs would present as an obvious deep crown fracture, occlusal secondary dentine discoloration or open occlusal pulp horns, and/or discharging tracts through the periodontal space or gingiva. Oral endoscopy has been shown to greatly improve identification of subtle dental changes such as small periodontal pockets, gingival recession, occlusal fissures, and changes to the occlusal secondary dental (Simhofer 2008a). In most cases, radiographs will aid in the diagnosis of apical disease. The sensitivity and specificity of radiography in the diagnosis of equine dental disorders are only 52-69% and 70-95% respectively, with periapical lucency, periapical sclerosis, and tooth root clubbing being the most reliable (Barakzai 2010). All of these radiographic changes are associated with chronic disease. Teeth showing occlusal secondary dentine defects often have deep carious lesions involving the crown and are prone to fracture.

Exodontia has been the treatment of choice for most chronic apically infected teeth. Oral extraction has been the preferred method of exodontia with the highest success rate and lowest rate of complications (Dixon 2008). Oral extraction can be challenging when attempting to remove a periodontal-intact, long crowned, hypsodont tooth in a young horse. There is potential to cause iatrogenic damage that can have long-term welfare ramifications from attempted extraction. Such potential complications have lead to the development of extra-oral approaches to extraction via alveolar plate removal, improved methods of retrograde repulsion, and minimally invasive buccal procedures (O’Neil 2011, Coomer 2011, Menzies 2014). After tooth removal, the secondary infection in the surrounding bone, soft tissues, or sinuses must be addressed. Management of these secondary problems can at times be challenging.
**Infundibular Disease** has been described as: infundibular cement hypoplasia, infundibular caries, or patent infundibulum and is beginning to be considered a developmental condition. This accounts for the fact that many of these problems are bilateral and affect multiple teeth in the same animal. Infundibular (infundibulum/-a: Latin, funnel) anatomy and development of the upper cheek teeth is complex. The infundibular invaginations of enamel develop as the crown enamel organ forms with the apical aspect of the infundibulum closing at about the time of tooth eruption. The cement lake that fills in this infolded enamel receives its blood supply from the coronal aspect of the tooth while it develops in the alveolar sac prior to eruption. Cement deposition within the infundibulum progresses from the occlusal surface apically. This process may be incomplete at the time of tooth eruption when the occlusal blood supply is disrupted. This disruption usually involves the rostral area of the tooth first, with mucosal communications with the distal infundibular blood supply observed using oral endoscopy for up to 6 month after tooth eruption.

After eruption, maxillary cheek tooth infundibulae display one or more small orifices in the center of the occlusal infundibular cementum. These canals extend through the infundibular cementum to the apical end of each infundibulum and represent the former location of blood vessels during dental development. The differentiation of mesenchymal cells into cementoblasts and subsequent cementum formation depends on adequate blood supply which is provided by these blood vessels derived from the dental sac.

Oral examination only allows visualization of the coronal surface of the infundibulum--not the more apical aspect. Digital radiology gives limited viewing of severely defective infundibula. Computed tomography allows improved imaging of the internal architecture of the teeth. Research conducted by Fitzgibbons et al, on the anatomy of maxillary cheek teeth infundibula in clinically normal horses, has helped to better understand infundibular anatomy, hypoplasia, and caries.
Techniques to fill or restore hypoplastic or carious infundibulae have been described since the 1940s. In the 1990s, the availability of instruments to reach the cheek teeth and air abrasion encouraged practitioners to begin attempting to diagnose and treat these deformed teeth without a good understanding of the disease process. Pearce has reported on 10 years of work with this technique in a clinical setting and has shown the process to be safe for the animal. More recent work by Horbal and Dixon has shown this technique to be of questionable value and lacking in cleaning and filling infundibulae deeper than 10mm.

Suggested Reading

Kopke et al. (2012) The dental cavities of equine cheek teeth: three-dimensional reconstructions based on high resolution micro-computed tomography, BMC Veterinary Research, 8:173


Special Dental Concerns of the Geriatric Horse

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Introduction

The age at which an individual animal is classified as geriatric can be based on chronological, physiological, or functional age. Physiological age differs between horses and depends on their use, genetic, and environmental factors. Geriatric horses and ponies make up an increasing percentage of the equine population and there is some evidence that more aged horses are being presented for veterinary treatment. (Brosnahan and Paradis 2003). A UK study showed horse >15 years represented 29% of the equine population (Ireland, Clegg et al. 2011). The prevalence of disease conditions has also been reported to increase with age and a high prevalence of disease in apparently healthy horses has been identified at veterinary examination (Chandler and Meller 2001). At least one dental abnormality was detected in 95.4% of horse over 15 years, with a large proportion of horses having generalized dental abnormalities (Ireland et al. 2012). In this study only 25% of horses with dental abnormalities on examination were reported by the owner to have a dental problem which supports previous USA studies showing dental disease in geriatric horses was almost always diagnosed during veterinary evaluation of another health problem for which the horse was being seen (Bronahan and Paradis 2003). Geriatric horses have a higher incidence of generalized health issues such as; pituitary dysfunction, laminitis, arthritis, gastrointestinal disease, heart murmurs, respiratory disease and tumors. This text will review anatomic changes and some of the more common dental pathology seen in older horses.

Older Horse Dentition

The change in normal equine dental anatomy with age results in dental disease that is specific to the geriatric equine. In addition, the culmination of dental disease throughout the life of the horse often results in advanced dental disease in older horses. The approach to treatment of specific dental disease conditions have to be adapted for older horses to compensate for the reduction in reserve crown and occlusal enamel. Ensuring oral comfort and maximizing masticatory ability are the mainstays of geriatric dental treatment. Recognition of dental disease common to older horses will ensure that the correct treatment can be applied. Furthermore, older patients often require long-term management changes, such as dietary modification, to manage dental disease effectively.

The natural ageing process of equine teeth contributes to the majority of dental disease observed in geriatric equids. Central to the ageing changes seen in equine teeth are that they are hypsodont and have a finite crown length. Various factors such as management and type of diet may also contribute to the rate at which teeth are worn and this may accelerate age related changes. Horses that have been fed a coarse forage based diet with lots of silicates may increase the amount of wear on the teeth.

The decrease in enamel thickness and enamel infolding further apically in teeth means less enamel is exposed on the occlusal surface as the teeth wear down. This results in teeth that are
not able to resist wear as effectively and the rate of attrition increases. As a result of the teeth narrowing apically, aged horses will have less tooth surface area, less tooth angulation, and the compression forces in each cheek teeth row are unable to maintain close interdental contact between teeth. This may result in multiple diastemata developing along a cheek teeth row, termed ‘senile diastemata’.

A recent detailed biomechanical study determined that in older horses, mandibular cheek teeth became more curved rostro-caudally, but did not change their dental positions. In contrast, the maxillary cheek teeth did not become more curved, but did have an increase in mesio-occlusal angle i.e. changed their dental position. As this changes the occlusal contact between maxillary and mandibular cheek teeth, it may contribute to changes in wear pattern observed in geriatric horses. Incisors also decrease in prevalence with age and the contact angle between maxillary and mandibular incisors become more acute. If this change of angle is not equal on both upper and lower jaws, it may adversely affect the normal wearing of the occlusal surfaces.

**Dental Disease in Older Horses**

Geriatric horses often have the culmination of dental disease that accrued throughout their lives. Due to the ageing process, dental disease such as worn teeth, periodontal disease and diastemata are very common in older horses. A study in a large population of donkeys, clearly showed a significant increase in the prevalence of dental disease as the animals aged. In particular there was a significant increase in dental disease in the 15 – 20 year old age range (du Toit, Burden and Dixon 2009). Incisor disease is commonly diagnosed in older horses and can be a source of chronic pain.

The mainstay of dental treatment in older horses is aimed at ensuring oral comfort and maximizing masticatory ability. The short remaining reserve crown limits dental crown reduction treatment in geriatric horses. This is especially so if prophylactic dental care has not been maintained throughout the horse’s life. Trying to achieve major changes in the cheek teeth row occlusal profile will be more detrimental to the patient at an advanced age.

Diastema is defined as a detectable interdental or interproximal space between adjacent teeth and is the most common dental condition predisposing the horse to periodontal disease. Not all diastemata should be considered problematic. Only when the diastema contributes to the stagnation of feed material and leads to the development of secondary periodontal disease, should it be considered clinically significant. The stagnation and fermentation of feed material causes a secondary anaerobic bacterial infection to develop at the gingival margin. As infection progresses, inflammatory mediators cause stretching and inflammation of the periodontal ligament. This can be very painful and lead to a loss of attachment at the gingival-cemental junction. Left unchecked, this periodontitis can lead to gingival recession with spread of infection into the sinuses and other adjacent osseous structures.

Diastema can be congenital or develop secondary to other pathology. This condition is under-diagnosed in clinical practice due to lack of awareness of the seriousness of the condition and poor dental examination techniques. Modern dental examination techniques require utilizing both digital palpation and visual inspection of the oral cavity. Proper patient restraint, a mouth speculum, bright light source, dental mirror and/oral endoscope are required to inspect all the
dental surfaces. Radiographs should be performed to assess the width and depth of the diastema and extent of horizontal and vertical bone loss within the periodontal pocket. Through the use of intra-oral or open mouth oblique extra-oral radiographs, the veterinarian is able to properly assess the number, depth, and severity of the diastemata; develop a treatment plan; and monitor progression (Barakzai and Dixon 2003, Baratt 2013). Treatment methods consist of dietary modification, diastema cleaning and packing, reducing occlusal pressure from opposing teeth, orthodontic treatment with odontoplasty, widening interdental spaces or tooth extraction. Diastemata diagnosed early and managed properly can prevent the progression of periodontal disease and allow affected horses to preserve their dentition into old age (Walker et. al. 2012, Bettiol and Dixon 2011, Easley and Odenweller 2016).

Equine odontoclastic tooth resorption and hypercementosis (EOTRH) is a painful, progressive condition that can affect the canine and incisor teeth in older horses. A current update on pathology, clinical findings, radiographic signs, and possible causes/associations will be discussed. Currently, extraction of severely involved teeth is the only tested treatment option available. Extraction techniques for canine and incisor teeth will be discussed.

An emerging pathology involving tooth resorption and hypercementosis has been recognized within the equine population. Tooth resorption itself is not new, and it is found in commonly studied species. The cause and pathophysiology of equine tooth resorption are still under investigation and demonstrating some distinct differences from the disease seen in other species, namely hypercementosis or invasive irregular cementum. The condition was first described in 2004 as a periopathogenic disease involving the incisor and canine teeth of the horse, and in 2006, a study formally recognized cemental hyperplasia and hypoplasia associated with the disease. In 2007 and 2008 tooth resorption was described as a major component of this pathology, and the disease was termed equine odontoclastic tooth resorption and hypercementosis (EOTRH).

Tooth resorption and hypercementosis affect both the incisors and canine teeth of the horses typically greater than 15 years of age. Recently, a small number of anecdotal reports of resorption and irregular cementum involving premolars have been confirmed by histopathology. The disease is characterized by internal and external resorption of dental structures sometimes associated with excessive production of irregular cementum on the exterior and interior of the tooth. The apical 1/3 to 1/2 of the tooth is commonly affected. The disease tends to start along the lingual/palatal aspect of the tooth with expansion in a mesial and distal direction. As the disease progresses, the pulp, dentin, periodontal ligament, and alveolar bone become inflamed and infected leading to reduced structural support for the teeth, degradation of gingiva, increased incisor angle, fistula formation, tooth fracture, and pain.

Periodontal inflammation is reported as a possible initiating trigger for tooth resorption, and it is suspected that chronic inflammatory mediators, particularly PGE2, an inflammatory factor that plays a primary role in the stimulation of osteoclasts, perpetuate the resorptive process. Osteoclastic activity has been shown to be influenced by several hormones and cytokines as well. A reparative reaction involves fibroblasts, odontoblasts and cementoblasts invading spaces between the osteoclasts to produce a cementum-like tissue to fill the dental defects. Depending on individual animal and tooth reaction, the balance between resorption and cementum deposition can vary resulting in the variety of stages seen sometimes in one mouth.
Histopathology of resorptive lesions and proliferative cementum has demonstrated abnormal location and activity of osteoclasts, odontoclasts, and cementoblasts. Osteoclasts in normal dentition typically reside against the bone surface occupying shallow hollowed-out depressions they have created called Howship’s lacunae. Histopathologic examinations of resorptive lesions revealed osteoclasts and odontoclasts residing in very large, atypical lacunae within bone, cementum, enamel and dentin. The term hypercementosis has been used in pathology reports to describe hyperplasia of normal cemental tissue and proliferation of irregular cementum, and this nondescript use of the word has led to some question regarding the true nature of cemental change reported in the past. Research into improved recognition and classification of the different forms of equine hypercementosis may help further reveal the nature of its association with tooth resorption and importance as a possible primary pathology.

Tooth resorption in general is a painful disease, and the level of pain appears to intensify with the severity of the lesions. A common initial sign of incisor pain reported by owners is a reduced ability/desire to grasp apples and carrots. Other signs of pain include sensitivity to bitting, head shaking, ptyalism, resistance to turning during work, shyness about the head, periodic inappetance, weight loss and decreased use of incisors for grasping and grazing. Some horses become incredibly adept at grasping feed with the lips, sliding it past the incisors and moving it into the mouth through the “bar” region. Watching how a horse eats hay prior to an oral exam is a good way to gauge the animal’s discomfort and stage of disease. Some horses that are in the earlier stages of disease, or with primarily hypercementosis may show no apparent signs of discomfort; however, level of pain can be a subjective assessment and difficult to evaluate in the horse.

Oral exam can be quite challenging because patients are resistant to manipulation of the lips and pressure on affected teeth. Placement and opening of an oral speculum can elicit alert and possibly dangerous behavior even under heavy sedation due to pain. Oral exam findings can include enlarged mandibular lymph nodes, decreased incisor angle not appropriate for age, prominent juga, loss of dental papillae, gingival and mucogingival fistulas, severe regional inflammation, purulent drainage, calculus and feed accumulation, missing teeth, hyperplastic
gingiva, gingival recession, bulbous enlargement of dental structures, tooth mobility, and supragingival regions of dental resorption. Resorptive lesions in older horses can be found under excessive tartar deposition on the mandibular (more common) and maxillary canine teeth. Exposing these lesions after removal of tartar will cause discomfort for the horse. The practitioner should be prepared to address these problems.

Evaluating tooth resorption and hypercementosis necessitates intraoral radiographs of both the incisors and canines to properly formulate a treatment plan. Radiographic findings typically include varying levels of dental resorption and hypercementosis, loss of the periodontal ligament space, disruption of alveolar and regional cancellous bone, osteomyelitis, and tooth fracture. A radiographic classification system for tooth resorption based on location was found to be useful in categorizing the type of resorptive lesions present in dogs. The system radiographically evaluated lesions for 7 types of resorption, which included external surface resorption, external replacement resorption, external inflammatory resorption, external cervical root surface resorption, internal surface resorption, internal replacement resorption and internal inflammatory resorption. In this recent study, all types of resorption were evident in the dog except for internal replacement resorption.

Treatment planning will depend heavily on clinical examination, radiographic findings, and the horse’s level of pain. Horses with mild subgingival resorption and no regional osteitis or alveolitis can be monitored with oral exam and radiographs as the pace of disease progression varies between teeth and individuals. It is not uncommon to see radiographically a variety of disease stages ranging from normal to severe throughout the incisors and canines. Once supragingival lesions, alveolitis, osteomyelitis, tooth fractures and extensive resorption of the reserve crown and root are detectable radiographically, extraction is recommended. Moderate to severe cases require staged or complete extraction of the affected incisor and canine teeth to alleviate infection and pain caused by this disease. Incisor extraction can be accomplished in two ways depending on the nature and severity of the pathology associated with the tooth/teeth. Singular incisor extraction by elevation and avulsion can be accomplished simply in mild to moderately affected teeth. In cases of multiple incisor and canine tooth extraction with severe
disease, a surgical approach is necessary to allow for complete removal of dental material, visualization of tooth and diseased structures, debridement and closure. In addition, a surgical approach increases the surgeon’s ability to deal with complicated extractions where reserve crowns and roots have fractured due to initial trauma and resorption.

Periodontal disease is commonly present with EOTRH. The cause of EOTRH has not yet been determined, but it is clear that the loss of dental and regional structure resulting from EOTRH opens the door for severe periodontal infection. The inflammation resulting from periodontal disease causes further degradation of both hard and soft periodontal structures. Treatment of periodontal disease will not stop EOTRH, but it will break the negative feedback cycle between EOTRH and periodontal disease temporarily. In the early stages of EOTRH where loss of the dental papillae and periodontium lead to regional feed accumulation, both veterinarian and owner can work together to keep the incisors and canines debris free. Daily tooth brushing and oral irrigation and frequent professional periodontal therapy (every 3-6 months) should be initiated. Antibiotic therapy can also be used to temporarily decrease the build-up of periodontopathogenic bacteria and regional infection. As EOTRH progresses, visual examination, radiographic findings and the patient’s signs of pain will determine when both owner and veterinarian need to consider extractions. Splinting of mobile teeth severely affected by periodontal disease and/or EOTRH is not recommended as it creates even more surface area for debris entrapment and unnecessarily extends the period the animal will be in pain.

In severe cases of EOTRH requiring extraction of all incisors, owners will need extensive presurgical counseling regarding the surgery, post-operative care, nutrition, possible complications and anticipated outcome. It is also recommended that horses requiring extraction of all incisors be referred to a veterinary dentist or surgeon experienced in this procedure as retrieval of all infected dental material and extraction of severely resorbed teeth can be technically challenging.

Horses with severe EOTRH display little discomfort after extraction of all incisors. Post-operative pain is controlled with non-steroidal anti-inflammatory medication and an antibiotic is given 7-10 days to prevent infection. Horses with no incisors are able to eat hay, and many owners and veterinarians report that these horses can graze by grasping forage with the lips and pulling. Although it is impressive that these horses can graze, it should be assumed that they cannot maintain themselves on pasture alone until proven otherwise. Therefore, owners will need to be aware that supplementation with hay, hay stretchers, senior feed or similar additives will be necessary for pasture horses. Once healed, horses will be able to return to full work, and many owners report improved disposition and increased energy.

The removal of all or most of the incisors can lead to extrusion of the tongue beyond the labial margin. The tongue appears to protrude most when horses are at rest, but there is tremendous
variation between individuals. Tongue protrusion can be a problem for horses in show where this is considered a violation, but horses appear to suffer no physical or mental trauma as a result of this complication.

References


