Intraoral Radiography of Equine Premolars and Molars  
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Abstract  
Intraoral radiographs can be valuable aids in the diagnosis and management of equine dental disease. A step-by-step method is described for taking intraoral radiographs. Use of this process facilitates diagnosis and treatment of dental disease and makes it possible to make a prognosis.

1. Introduction  
It has been widely recognized in equine veterinary medicine that radiographic images aid in the diagnosis, treatment, and management of problems related to teeth and their surrounding structures [1-4]. Standard views in equine dental radiography generally include lateral, dorso-ventral, and oblique views [3,5] of the arcades and are taken using extraoral film. These views are challenging to interpret because of the superimposition of oral structures. An open-mouthed oblique technique that separates the arcades [6] was recently described. This technique facilitates recognition of abnormalities of the clinical crown. Reserve crown and apical abnormalities remain obscured by the overlying oral structures.

As equine dentistry evolves, treatments for many conditions including endodontic problems, periodontal disease, and fractured and diseased teeth are being developed and refined. These procedures require more detail of the affected tooth (teeth) and associated tissue. Radiographic views that isolate oral structures without superimposition contribute to success, because they help veterinarians provide more accurate diagnoses and appropriate treatments to these problems.

Intraoral radiography is the accepted standard in other species for diagnostic evaluation of dental disease [7,8]. In horses, various intraoral techniques have been used [9,10]. These techniques include the use of standard, commercially available intraoral film in self-contained packets. The largest film available is the occlusal film, which measures 2.25 x 3 in. These occlusal films have been used in horses with minimal success [9,10]. The film requires a very specific alignment of the tube head, object, and film to get an accurate image. The film is a non-screen film and requires high levels of radiation with a long exposure time [10]. This extended exposure time usually necessitates general anesthesia [10].

Gibbs [9] describes an intraoral technique that uses an intensifying screen and film enclosed in a light-proof plastic bag. Good quality images were obtained with this method.

The purpose of this paper is to describe a modification of Gibbs' technique, which can be used to obtain an accurate image. This modification uses a vinyl cassette that contains a single card-mounted rare earth intensifying screen. The intensifying screen is matched with appropriate film, and the image is generated using a portable X-ray unit, which is commonly found in equine practices.

2. Materials and Methods  
Radiographic Equipment  
The X-ray generation unit was a 20-mA, 100-KVp high-frequency machine [a]. High-speed rare earth film [b] was used with a single card-mounted high-speed rare earth intensifying screen [c]. The film and screens were 4 x 8 in.
Vinyl cassettes held the film and the screens. After insertion of a single intensifying screen and film, the cassettes were folded, closed, and sealed around the edges with radiolucent tape. With this seal, the cassette was closed to light and moisture (Fig. 1 and Fig. 2).

Maxillary Projections
In human dentistry, a parallel projection technique is used where the film is parallel to the tooth root. The presence of a high maxillary ridge in humans allows for use of this parallel technique. Equine maxillary anatomy is such that the ridge is shorter and the palate is flatter, thus precluding the use of the parallel projection technique. Additionally, equine teeth are hypsodont in character, with their long reserve crown and root structure extending well into the supporting bone. This position of the tooth within the bone precludes the use of a parallel technique.
The maxillary views taken with the film in the manner described by Gibbs [9] used an angle that was dictated by the patient's age. The X-ray formed a 70 - 80º angle with the film in a 2-yr-old horse and a 60º angle in older horses. In the current study, the angle of incidence was the same for young and mature horses. However, for patients that were 20 yr of age and older, the angle of incidence was reduced to 45º. Applying this technique resulted in an anatomically correct image of the tooth in these patients. The entire tooth, from crown to apex, was imaged on a single film.

Mandibular Projections
In humans and small animals, the parallel technique is used for posterior mandibular images. Images of more occlusally oriented anatomy of the equine cheek teeth were best obtained with intraoral projections. This includes images of the clinical crown and of occlusally oriented periodontal structures. These projections were taken with the parallel technique. For best views of apical anatomy in young and mature horses, the lateral oblique extraoral technique at 45º remains the technique of choice. Apical anatomy of horses over 20 yr of age can be imaged with the parallel technique.

Bisecting Angle Technique
In small animals, images of maxillary arcades and anterior mandibular arcades are obtained with the bisecting angle technique. This technique can be used in equine dental radiography.
Radiographs of the maxillary cheek teeth are obtained by placing the vinyl cassette on top of the tongue and against the palate in as flat a position as possible. The film was slightly angled so that it extended from the occlusal surface of the side being radiographed to the gingival margin on the opposite side. The angle formed by the planes of the long axes of the tooth and the surface of the film was bisected. The tube head was positioned perpendicular to this bisecting angle. The resulting image closely approximated the actual size and orientation of the tooth and surrounding structures. This angle was adjusted toward a more steep projection in younger animals because of the more dorsal position of the apices. This angle is 70 - 80º in most patients (see Fig. 7 and Fig. 8). The result was a modification of the previously described bisecting angle technique [11]. The foreshortening of the image was considered when interpreting the film (Fig. 3, Fig. 4, Fig. 5, Fig. 6, Fig. 7 and Fig. 8).
Radiographic Technique

Film focal distance was 40 cm in all projections. The collimator was opened to its maximum aperture. The settings for the X-ray machine varied depending on the location of the area of interest. Occlusally oriented problems such as periodontal disease required 50 KvP and 0.5 mA. More apically oriented areas of interest required greater exposure, and the machine was set at 60 KvP and 0.6 mA.

Sedation and Anesthetic Protocol

The patient was sedated with an IV injection of detomidine [e] at 0.02 mg/kg [12] in combination with xylazine [f] at 0.2 mg/kg [12]. After 5 min, additional IV sedation was administered using xylazine at 0.2 mg/kg together with butorphanol [g] at 0.01 mg/kg [13]. After initial sedation, 5 - 10 ml of lidocaine [h] was sprayed topically onto the oral mucosa. This desensitizes the tongue, palate, and buccal mucosa to help limit motion caused by sensitivity of these soft tissues.

Speculum - The Stubbs Speculum [i] was used. Its lateral components do not obstruct the X-ray beam. When images are taken that include the second premolars, the poll strap and lateral brackets are retracted away from the path of the X-ray beam (Fig. 9).

Film Processing

A standard automatic processor was used for developing equine dental films.

3. Results

Interpretation

Radiographic findings in equine dental films are similar to those of small animals. Variations in the height of the crestal bone, identification of the periodontal ligament space, density of the lamina dura, changes in density of the tooth, and detection of
fragments of fractured teeth are all seen in equine intraoral radiographs.

Use in Periodontal Disease
Case 1 - A 22-yr-old quarter horse mare was presented with a periodontal pocket between the left maxillary second (206) and third (207) premolars. The pocket is shown in Figure 10, using a mirror for visualization. The left quadrant was radiographed using the bisecting angle technique (Fig. 11 and Fig. 12).

Case 2 - A 6-yr-old warm blood gelding was presented with the complaint of resisting the bit on the right side. Examination revealed several enamel points and a periodontal pocket between the right maxillary first and second molars (109 and 110) (Fig. 13 and Fig. 14).

Use in Surgery
Case 3 - A 6-yr-old quarter horse gelding was presented for surgical repulsion of a fractured left maxillary first molar (209). The majority of the crown of the tooth was missing. The remaining crown consisted of large fragments of the peripheral enamel. Root fragments remained in the socket. The intra-operative image taken after the largest fragments were repulsed revealed a small fragment of the distal enamel of the periphery of the tooth. This fragment may have been missed on examination of the alveolus during surgery, but it was easily detected with the use of an intraoral radiograph (Fig. 15 and Fig. 16).
4. Discussion
Diagnostic quality radiographs of equine dental structures can be obtained with modified intraoral film and cassettes. These films show the detail of dental and periodontal anatomy necessary for an accurate diagnosis. The diagnostic quality of the images facilitate treatment planning.

The use of a rare earth intensifying system allows for significant reduction in exposure to radiation as well as reduction of time of exposure. The short time needed to achieve adequate exposure provides an additional benefit: minor movement by the patient does not compromise the image.

The sedation and anesthetic protocol used minimizes movement in even the most difficult patient.

Radiographic evaluation of equine periodontal disease is important for two reasons. First, it is important in obtaining detailed information regarding the pathological condition. Second, knowing the amount of attachment loss involving periodontal ligament and alveolar bone is important when making the treatment plan. Although treatment of periodontal disease in humans and small animals is more advanced than it is in equine patients, characterization of the pathological process in the equine patient is critical for development of more sophisticated diagnostics and subsequent treatments.

The importance of radiographs is demonstrated in the first two cases. Clinically, both cases had a significant periodontal pocket. The difference is that there is no attachment loss or bone loss in case two, whereas significant attachment loss has occurred in case one. Management of the two cases differs as well as the prognosis. As attachment loss progresses, the tooth tends to be lost sooner if appropriate measures are not implemented. In case one, the affected tooth was treated locally and reduced from occlusal forces. This allowed periodontal healing to occur. The tooth in case two was simply treated locally.

The second significant value of intraoral radiographs is assessment of response to therapy. Treatment response cannot be properly monitored without focused radiographic analysis of the affected tooth and associated structures.

Intraoral radiographs can be used intra-operatively when repelling a fractured cheek tooth. Knowing the location and shape of the root reduces the amount of exposure of the operative site. This also reduces the need for repositioning the patient to obtain intra-operative extraoral radiographs and thus, reduces operative and anesthesia time. The cassette is easily placed in the mouth alongside the endotracheal tube and the tongue. Then, the radiograph is taken, and the film is developed.

Clinical use of intraoral radiography is encouraged. The ability to diagnose disease and monitor treatments of dentally related problems will facilitate further advancement in equine dentistry. The primary benefactor of this improvement will be the patient.

Footnotes
[b] DIS Quality Green 400, Diagnostic Imaging Systems, Rapid City, SD, 57701.
[c] Green Regular 400 Speed Rare Earth Intensifying Screen, Diagnostic Imaging Systems, Rapid City, SD, 57701.
[d] Duct Tape, Ace Hardware, Oak Brook, IL, 60521.
[g] Torbugesic, Fort Dodge Animal Health, Fort Dodge, IA, 50501.
[h] Lidoject, Burns Veterinary Supply, Westbury, NY, 11568.
[i] Stubbs Equine Innovations, Johnson City, TX, 78636.

References


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