How to Obtain Diagnostic Dental Radiographs

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1. Introduction
Digital radiography has significantly improved the ability to diagnose dental disease in the horse. Direct digital radiography units allow diagnostic images to be readily obtained. However, practitioners may find difficulty in obtaining radiographs of the horse’s skull that are of diagnostic quality. Familiarity with standard radiographic techniques is critical to obtaining quality images and then correctly interpreting dental radiographs. Standard radiographic projections have been described in depth in multiple publications, and these are recommended for the reader to explore additional sources of information.1–7 The recommendations offered in this manuscript can help the practitioner improve their skills in dental radiography, which will then improve recognition of radiographic signs of dental and paradental pathology.

2. Materials and Methods
Radiography complements but does not replace a thorough visual oral examination. A detailed physical examination, appropriate sedation, and complete oral and dental examinations will allow the veterinarian to identify abnormalities that will indicate radiographs as the next diagnostic step. It is the exam that identifies potential problems within an area in the mouth so that a complete imaging study can be performed and the practitioner can then focus on identifying subtle radiographic changes with the tooth or teeth in question that were identified during the detailed examination. In dental referral practice, the author reviews and consults on referral radiographs on a daily basis. Some of the most common problems encountered when taking dental radiographs are consistent with those previously reported.8

- Motion artifact.
- Exposure irregularities and image processing errors.
- Positioning errors and superimposition of individual teeth and arcades.
- Obtaining an incomplete series of radiographs of the affected arcade.
- Failing to image the opposite “normal” side.
- Lack of radiographic marker or incorrect orientation of radiographs.
- Lack of a complete oral exam resulting in inability to correlate radiographic findings to examination findings.

Profound sedation is required to help reduce motion artifact in dental radiography. The author’s preferred sedation protocol is intravenous administration of detomidine8 (0.01–0.02 mg/kg) used in combination with butorphanol8 (0.005–0.01 mg/kg). Appropriate sedation lowers the horse’s head, which can then be rested on a low support, such as a stool or
headstand. Stabilizing the radiographic sensor plate on the same support object greatly diminishes motion artifact. When imaging incisor and canine teeth via an intraoral technique, it is especially important (even if a speculum with radiolucent bite plates is used) that sedation is adequate so that the horse is not stimulated to chew when the plate is felt in the mouth. Differences in tissue density may require more than one radiographic exposure; however, most digital system algorithms can be adjusted to compensate for variations in tissue thickness. The use of a large (12 in x 14 in to 14 in x 17 in) sensor plate or cassette allows imaging of entire arcades, which helps to maintain spatial relationships when evaluating the radiograph. Appropriate positioning of the sensor plate and x-ray generator are necessary to obtain diagnostic images. Knowledge of skull anatomy and topographic landmarks is necessary to guide correct positioning of the patient’s head, sensor plate, and x-ray generator. With closed-mouth radiographic projections, erupted crown can be obscured by superimposition of the crowns of the opposite arcades. Superimposition is addressed by obtaining open-mouth views via use of a speculum or other method to open the mouth. Standard full-mouth speculums may have too much metal laterally that will interfere with imaging. Aluminum speculums are more radiolucent but still produce opacity on the image. Other options to keep the mouth open include a 4 in x 4 in block of wood, a PVC pipe, or a large rubber dog chew toy. Open-mouth lateral oblique views allow for optimal image quality as the superimposition of contralateral cheek tooth rows is reduced or eliminated. The practitioner should become well versed at obtaining standard views for maxillary and mandibular cheek teeth, incisors, canines, and sinuses. Taking a complete series of radiographs is important to allow evaluation of each tooth and the arcade as a functional unit. Limiting radiographs to one view of the arcade in question generally does not provide a diagnosis. A minimum series of 6 standard views for the skull and cheek teeth (dorsoventral, latero-lateral, open-mouth right and left lateral dorsal 30° ventral oblique, and open-mouth right and left lateral ventral 50° dorsal oblique; Figs. 1B, 1C, 2B, 2C, 4B) is

Fig. 1. Three images of the same horse with periapical lysis, blunted apices of tooth 110. A, Motion artifact in addition to incorrect mesial to distal positioning; this can be corrected by adjusting the generator position to achieve separation of cheek teeth. B, Open-mouth right lateral dorsal 30° ventral oblique provides clear interproximal spacing, and the practitioner is able to evaluate mesial and distal buccal roots. C, Open-mouth left lateral dorsal 30° ventral oblique provides a clear image of the contralateral arcade for comparison.

Fig. 2. Three images of the same horse with periapical lysis and blunted apices of tooth 208. A, Overexposed image, motion artifact and incorrect mesial to distal positioning, incorrectly oriented image although it is labeled as left side. B, Lateral dorsal 30° ventral oblique with clear interproximal spacing is present, and the practitioner is able to evaluate mesial and distal buccal roots. C, Open-mouth lateral ventral 50° dorsal oblique allows evaluation of the palatal root.
recommended. Intraoral imaging of incisors and canines is best performed using a radiolucent tunnel or speculum with radiolucent bite plates to protect the sensor and avoid obscuring the area of interest. A series of 6 views (bisecting angle technique, dorsoventral and 15° oblique angle to the left and right of maxillary incisors and ventrodorsal and 15° oblique angle to the left and right of mandibular incisors; see Fig. 3B–D) is warranted to assess all rostral dentition. Additional intraoral obliques or extraoral imaging of canines may also be necessary. The dorsoventral or ventrodorsal angulation outlined in the recommended standard lateral oblique views also may need to be adjusted depending on the age of the horse and length of reserve crown. Slight repositioning in a caudo-rostral or rostro-caudal direction may also be required to eliminate obliquity and overlapping of adjacent cheek teeth. Practitioners are encouraged to image both left and right views for comparison of the “normal” side to the side of interest. Bilateral images are necessary for reliable radiographic interpretation; because of the changing angles and anatomy of dentition with age, the horse serves as its own control subject. Subtle radiographic changes should be compared to the normal side to aid in radiographic diagnosis and help decision-making if referral for more advanced diagnostics, such as computed tomography, is indicated. In addition, radiography of both sides allows identification of bilateral pathology. Radiographs taken without a marker make it difficult to know which side is which when both sides of the skull are imaged. Radiographs should be taken with a right/left marker on the sensor indicating sensor placement. Proper labeling of the radiographs is essential for accurate interpretation. The American Veterinary Dental College (AVDC) convention of presenting the radiographs with “labial mounting” is used in conjunction with the American College of Veterinary Radiology (ACVR) terminology. Radiographs are presented so the viewer is looking at the images as if looking into the horse’s mouth. The right cheek teeth are presented with the horse’s nose on the viewer’s right. The dorsoventral views of the skull are presented with the nose down and the horse’s left side on the viewer’s right. Crowns of the maxillary incisors are pointed down and mandibular incisors are pointed up as if one were standing in front of the horse.

3. Results

Once appropriate diagnostic radiographs are acquired, systematic review of each radiograph taken should include assessment of the following:

- Is there motion artifact and is exposure appropriate to evaluate the image?
- Tooth numbers and anatomy: Is the entire arcade included on the image? Are individual teeth and roots visible with interproximal spaces and periodontal ligament spaces clear? Are there missing teeth or supernumerary teeth? Is evaluation of teeth for root blunting, resorption, hypercementosis, or malformation possible?
Alveolar anatomy: Can periapical alveolar bone radiopacity (sclerosis or lysis) be evaluated? Can the width of periodontal ligament space be evaluated? Can evaluation of alveolar margins and assessment of vertical or horizontal bone loss be performed?

Paradental sinuses: Are there fluid lines, soft tissue density, cystic structures? Are fine bony structures clearly visible or is the image overexposed?

Critically evaluating each radiograph will help the operator improve their technique. The practitioner will become accustomed to looking for specific changes that will lead to a diagnosis from quality images instead of guessing at nondiagnostic images. Consistency in positioning and technique improves the clinician’s ability to recognize normal and abnormal anatomy and allows identification of radiographic signs of dental and sinus disease. Figures 1–4 are provided to highlight the differences between nondiagnostic and diagnostic dental radiographs.

4. Discussion

Proficiency with the standard radiographic views of equine cheek teeth will allow the practitioner to obtain diagnostic images for immediate use in the field or for consultation. Dental disease diagnosis requires quality radiographic technique that is consistently applied in veterinary practice. There is significant age variation of radiographic appearance of cheek teeth and their apices, and an appreciation of normal variations is required for accurate interpretation of dental radiographs. By recognizing and preventing radiographic technical difficulties, image quality and diagnostic accuracy will improve. Becoming proficient with taking and interpreting dental radiographs will increase the level of service practitioners provide and thus improve the overall health care of their patients. It is important to understand the limitations of radiography to clearly diagnose dental disease in complicated cases. Additional advanced imaging with computed tomography, nuclear scintigraphy, or magnetic resonance imaging may be required to better characterize the extent and exact location of disease involving multiple teeth or sinus disease.

Acknowledgments

Declaration of Ethics

The Author has adhered to the Principles of the Veterinary Medical Ethics of the AVMA.

Conflict of Interest

The Author has no conflicts of interest.

References and Footnotes


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