INTRAORAL RADIOLOGY
BEYOND WHAT OUR EYES CAN SEE

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Oral radiology is the cornerstone to the diagnosis, treatment planning and monitoring of oral disease. It allows us to determine what pathology lies where our eyes cannot see, and to determine treatment protocol based on factual information.

After a thorough oral evaluation of the patient under general anesthesia any area of pathology should be radiographed for proper evaluation. Radiographs are indicated in the following instances: periodontal disease, pre and post extraction, endodontic disease (fractured teeth, discolored teeth, worn teeth), missing teeth, caries, tooth resorption, fractures, nasal discharge, oral masses and temporomandibular joint diseases.

Intraoral films (D speed/ Ultraspeed^{TM}) can be used with a standard x-ray machine using a technique of 100mA (milliamperes), a film focal distance of 12-16 inches and an exposure time of 1/10th second. The kVp (kilovoltage peak) will vary from 50-85 dependent on patient size. This technique requires moving the patient to achieve the correct bisecting angle because the tubehead is often stationary. As with standard radiographs, if the dental radiographs obtained with the standard x-ray unit are too light, increase the kVp or exposure time and if the radiographs are too dark, decrease the kVp or exposure time.

To facilitate the use of dental radiology, a dental x-ray unit is invaluable to a veterinary practice. It enables intraoral radiographs to be taken 'chairside' at the location of your dental procedure. The extension arms allow vertical, horizontal, and rotational movement of the tubehead without changing the patient's position. Dental x-ray machines may be purchased new or used. Their use is straightforward. All x-ray units have a fixed kVp and mA. Based on the patient size and tissue thickness to be imaged, exposure time is the only adjustment to be made.

To equip the dentistry department of a practice with intraoral x-ray capabilities, it is necessary to purchase a dental x-ray unit, chairside darkroom, dental viewbox and dental x-ray film. Start up costs are $4500 - $5000. At least half of the dental procedures require radiographs. Return on investment, although dependent on the number of dental procedures performed, will likely take less than a year.

Digital imaging is a recent technical advancement in dental radiology. The dental radiograph machine is still used to expose the image, but a wired sensor or phosphor plate is used instead of film. After exposure of the wired sensor the image is transferred to a computer screen which can be viewed within seconds. The digital system requires less radiation to produce an image. When the phosphor plate is exposed it is placed in a scanner and the image is viewed on the computer screen in 1-2 minutes. With both systems, the image produced on the computer screen and can be enlarged or enhanced as needed for interpretation. The software systems vary by company. The advantages to these systems are the ability to manipulate and store images on the computer, print images for clients, less radiation exposure in the case of direct digital, and decreased time to process and store film. The disadvantage of the direct digital system is that there is no size 4 sensor available so imaging large teeth may require more than one radiograph. The advantage of the indirect digital system (phosphor plates) is that sizes 0, 1, 2, 3 and 4 are

available. The other disadvantage of digital systems is that the images have slightly less detail than standard film and cost, which varies from $6000 – 20000 depending on the system utilized.

Dental x-ray film is small, non screen film which provides greater detail than the screened film that is typically utilized with standard x-ray machines. Dental x-ray film is available in several sizes and speeds. The film speeds most commonly used in veterinary dentistry are D (ultra speed) or E (ekta speed). Speed E film is twice the speed of D film, requiring half the exposure with a slight loss of quality. Dental films are small in size and are numbered smallest to largest 0 to 4. The two sizes most commonly used in veterinary medicine are size 4 and size 2. Occlusal films (size 4, DF50) are used to image a larger area. Because of the limited space in the oral cavity of canine and feline patients, periapical film (size 2, DF 58) is utilized to radiograph the majority of the teeth in our canine and feline patients. Intraoral x-ray film comes in a moisture resistant packet. There is black paper on either side of the x-ray film. A layer of lead foil is located at the back of the packed next to the tab opening. Lead foil protects the film from secondary radiation which may cause the film to fog. A dimple or dot is found in the corner of the film packet. The convex (raised) surface of the dimple faces toward the x-ray beam during exposure. After developing the dimple is used to distinguish the right side of the mouth from the left.

Dental rapid developer and fixer are utilized for film development. These solutions may be placed in small containers within the existing darkroom. The use of a chairside darkroom, however, is more convenient as it allows the film to be developed in the dental area. Four containers are located in the chairside darkroom: one for developer, one for fixer and two for water. With both hands inside the chairside darkroom, remove the exposed x-ray film from the envelope and place it in a film clip. First place the film in the water first for 5 seconds to hydrate the emulsion. Then place it in the developer for 10-15 seconds dependent on the solution and temperature. After rinsing in water, place the film in the fixer for twice the developing time while agitating. After a final water rinse, the film may be viewed using a dental view box to make a diagnosis. It may be helpful to use eye magnification or a magnification lens in film interpretation. After viewing, place the film in the fix for 20-30 minutes and then in the water rinse for 20-30 minutes. Gently rinse the films under running water and then air dry. The films should be labeled and kept as part of the patient's medical record.

Film processing errors can result in radiographs that are difficult to read. Underdeveloped or underexposed films are white or washed out in appearance. Overdeveloped or overexposed films are dark or black in appearance. When films (especially size 4 films) appear to have 'clouds' superimposed on them, it is due to inadequate agitation in the fix. Place the film back in the fix and gently swirl it until the 'cloudiness' disappears. When the chemicals in the chairside darkroom are exhausted the films will appear gray with loss of definition. Depending on the frequency of use of the chairside darkroom, most chemicals will last for 20-30 size 2 films.

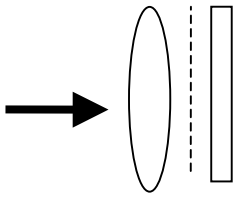
As with any type of radiation, it is important to observe radiation safety guidelines. The amount of radiation exposure should be kept to a minimum. If possible, leave the room while taking the radiograph. Wear a lead lined apron, thyroid protector and a film badge. If it is not possible to leave the room, stand at least 6 feet from the x-ray cone and stand at a 90-135 degree angle behind the direction of the cone.

To obtain a dental x-ray, place the x-ray film in the patient's mouth with the white side of the packet and raised dot toward the x-ray cone. The tab side of the film packet should be away from the x-ray cone. Gauze sponges or commercial film holding devices may be utilized to hold

the film in the proper position. Be sure to place the film far enough inside the mouth so that the entire tooth crown and root project onto the film.

There are two intraoral radiograph techniques commonly utilized in veterinary medicine. The parallel technique is ideal to minimize distortion. Place the film parallel to the tooth and the x-ray beam is directed perpendicular (90 degrees) to the film and tooth. (Figure 1) Due to the anatomy of the oral cavity, this technique may only be used to image the mandibular molars, the caudal mandibular premolars and the nasal cavity.

Figure 1: Parallel technique



The bisecting angle technique is utilized to minimize distortion when taking radiographs of the maxillary teeth, the mandibular canines, incisors, and anterior premolars. To utilize this technique place the film as close to the tooth as possible. For the maxillary teeth the film is placed parallel to the palate with the edge of the film on the edge of the tooth to be radiographed and the rest of the film in the oral cavity. For the mandibular incisors, canines and anterior premolars the film is placed inside the mouth, with the edge of the film on the edge of the tooth to be imaged and the film is parallel to the palate. This results in the maximum amount of film area to project the image onto.

The angle formed by the long axis of the tooth and the plane of the film is bisected by an imaginary line called the bisecting angle. The tubehead is positioned perpendicular to the imaginary bisecting line (Figure 2) and is centered over the tooth crown and root. The result is a fairly accurate depiction of the tooth. (Figure 3)

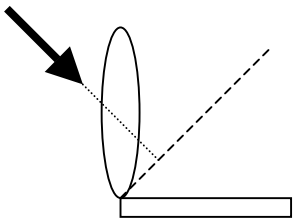


Figure 2: Bisecting angle technique

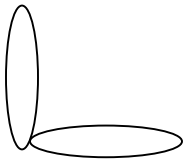


Figure 3: No size distortion in resulting image

In cats, radiographs of the maxillary premolars and molars utilizing the bisecting angle technique results in superimposition of the zygomatic arch over the apex of the teeth. To eliminate this superimposition, an extraoral view of the feline maxillary premolars and molars may be utilized. Alternately, with the intraoral radiograph, the premolars and molars may be intentionally elongated to eliminate the superimposition of the zygomatic arch by decreasing the vertical angulation of the tubehead.

Vertical angulation refers to the up and down movement of the tube head. Vertical angulation determines how accurately the length of the object being radiographed is reproduced. To ensure adequate representation of the tooth being radiographed, the tubehead position must be perpendicular to the bisecting angle. The image is elongated if tubehead did not have enough

vertical angulation. (Figure 4) The image is foreshortened if the tubehead had too much vertical angulation. (Figure 5)

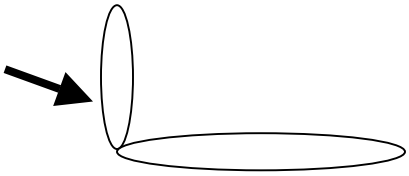


Figure 4: Elongation

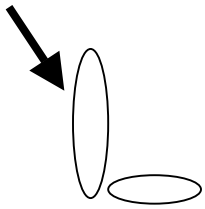


Figure 5: Foreshortening

Horizontal beam angulation refers to back and forth movement of the tubehead from the nose of the patient to the ear of the patient. Changes in horizontal angulation of the tubehead allow one to determine which object is palatal or lingual and which is buccal when objects are superimposed. The mesiobuccal and palatal roots of the maxillary fourth premolar are usually superimposed on each other when a standard bisecting angle film is taken and the horizontal angulation directs the x-ray beam at right angles to the tooth and film. (Figure 6) To separate the front two roots a horizontal tube shift technique is utilized. The tubehead is oriented as previously described for the bisecting angle technique and then is shifted slightly rostral or caudal. To determine the resulting position of the roots on the radiograph, the SLOB rule (Same Lingual, Opposite Buccal) is used. Objects on the lingual side (palatal) will move in the same direction on the radiograph as the change in position of the tubehead and objects on the buccal side will move in the opposite direction as the change in position of the tubehead. So, if the tubehead is moved caudally, the lingual root (palatal) will be the most caudal root on the radiograph and the mesiobuccal will be the most rostral. (Figure 7) If the tubehead is moved rostrally, the lingual root (palatal) will be the most rostral on the radiograph and the mesiobuccal will be the most caudal. (Figure 8)

Figure 6: Standard bisecting angle technique

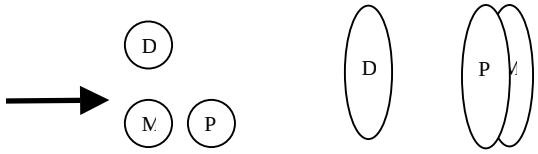


Figure 7: SLOB rule tubehead caudal

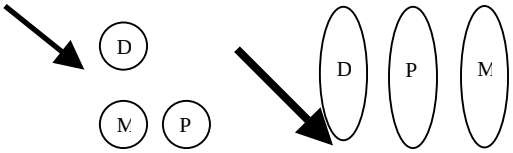
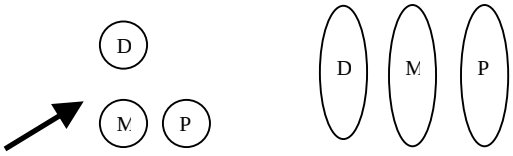


Figure 8: SLOB rule tubehead rostral



Dental radiography is an essential part of the evaluation of oral and maxillofacial diseases. In combination with a complete extraoral and intraoral examination, including the use of a dental probe and explorer, intraoral radiography makes dentistry a science based on fact and provides veterinarians with the tools to properly assess and treat oral disease.

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Mulligan T, Aller S, Williams C: Atlas of Canine and Feline Dental Radiography. Trenton, New Jersey, Veterinary Learning Systems, 1998.

Wiggs R, Lobprise H: Veterinary Dentistry Principles and Practice, Philadelphia, Lippincott-Raven, 1993.

For further information and a copy of the dental radiograph 'cheat sheet' email me at: fvvds@sbcglobal.net