

## DENTAL RADIOLOGY

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### **Dental Radiograph Units:**

Radiographic exposure<sup>i</sup> is controlled by 3 components: kVp (kilovolt peak), MA (milliamperage), and exposure time. KVP controls the “quality” of the x-ray beam. This is the power of each particular x-ray particle which controls the penetration of the beam through tissues.

The quantity of the exposure is controlled by MA and time of exposure. The higher the MA, the more X-rays produced over the time period. Multiply this number by the exposure time and you will get the total number of x-ray units.

Since there is not a significant amount of variation of tissues in oral radiology, the KVP and MA are set constant on dental radiology units. The only variable factor is time. This is measured in seconds or pulses. One pulse is equal to 1/60 of a second. Most standard dental radiology units<sup>1</sup> have a dial or digital control for the exposure and it is set by the operator based on a technique chart. Recently, a veterinary product<sup>2</sup> has become available which has a computer that sets the exposure based on the size of the patient, the speed of dental film used, and the particular object tooth. This takes a lot of the guesswork out of the exposure setting.

### **Dental Radiographic Film:**

Dental film is non-screen film<sup>ii</sup>. This means that it is directly exposed by the x-ray and does not require an intensifying screen. This gives much more detail than standard radiographic film, but requires a higher amount of exposure. It is packaged in its own paper or plastic sleeve, to protect it from light and the oral environment.

There are two types of dental film commonly used in dental radiology. These are Ultra-speed “D” and Ektaspeed “E” film<sup>3</sup>. In addition, “F” speed film is being introduced. The difference is in the size of the silver halide crystals and secondary to this the amount of exposure required to expose the dental film. “E” speed film requires approximately ½ the amount of radiation for exposure than “D” speed film<sup>iii</sup>. This decreases exposure to the patient and staff as well as decreases the wear and tear on the x-ray unit. There is a slight decrease in resolution with E-speed film owing to the larger crystal size, but according to most experts, the difference is negligible. Therefore, it is recommended in human dentistry to use “E” speed to decrease exposure time<sup>iii</sup>. The “E” speed film is more technique sensitive, however, in both the exposure and development of the image. This may be frustrating for the novice, therefore it is generally recommended that practitioners start with “D” speed and advance to “E” speed when they are more comfortable with the settings and positioning. One important point to remember, is that “E” speed and “D” speed have different “safe” lights. “E” speed requires a red filter or safe light whereas “D” speed is amber. If you are unsure of the type of film, you can tell by the color of the back side of the film. “D” speed film has a mint green back, while “E” speed is light purple.

There are several different sizes of dental film available (4, 3, 2, 1, and 0). The most common sizes used in veterinary medicine are 4, 2, and 1. Size 3 are bite wings and are generally not used in veterinary medicine. However, there are some that have loops that can be fit around the crown of the tooth for evaluating the crown and proximal surfaces of the teeth<sup>iv</sup>. Size 4 (occlusal) film is the largest available, it is used mostly in large breed dogs or when taking whole mouth radiographs. For small dogs and cats and most any single tooth radiograph, size 2 (standard) is commonly used. For the mandibular first and second premolars, and very small cats and puppies size 1 (or 0) (periapical) are used.

Another consideration in selecting film size is cost. Size 4 film is about 3 times the cost of size 2. Therefore, if you can use a size 2, it is recommended. However, it is much easier to position size 4 films, allowing for much more latitude in positioning. This will result in less retakes. Therefore, the less

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<sup>1</sup> Gendex: Dentsply/Gendex Division. 4379 S. Howell Ave., Suite 2, Milwaukee, WI, 53207.

<sup>2</sup> AFP imaging Corporation. 250 Clearbrook Road, Elmsford, NY 10523.

<sup>3</sup> Eastman Kodak Co. HSD/Dental Products, 343 State Street, Rochester, NY, 14650.

experienced may consider practicing with size 4 film and graduating to size 2 when a level of skill is obtained.

**Digital Dental Radiology:** There are numerous human and currently 2 veterinary digital systems. These are excellent if somewhat pricy means of obtaining dental radiographs. The only major problem currently is the lack of a number 4 plate in digital. The major advantages to these systems are the decrease in radiation exposure, rapidity of the development, and that you can reposition the sensor if the view is not correct the first time.

### **Taking a dental radiograph:**

#### **Step 1: Patient positioning**

Position the patient so that the area of interest is convenient to the radiographic beam. In general this is where the object is "up". For maxillary teeth, the patient should be in ventral recumbency. For mandibular canines and incisors the pet should be in dorsal recumbency. Finally, for maxillary cheek teeth, the patient should be in lateral recumbency with the affected side up. This being said, in our practice virtually all radiographs are exposed in lateral recumbency. This takes some getting used to, but decreases the number of times a patient must be rolled when doing surgical or endodontic procedures.

#### **Step 2: Film Placement within the patient's mouth**

There is an embossed dot on the film. The convex side of this should be placed towards the x-ray beam. In most films, this side is pure white. The opposite or "back" side of the film will usually be colored (purple or green). Place the film in the mouth so that the entire tooth (crown and entire root surface) is covered by the radiograph. Remember, the roots of all teeth are very long. This is especially true of canine teeth, which are longer than you think. Always err on the side of having the film too far in the mouth to ensure you do not cut off the root apexes. The film should be placed as near as possible to the object (generally touching the tooth and gingiva) to minimize distortion.

#### **Step 3: Positioning the beam head**

There are two major techniques for positioning the beam head in veterinary patients. Both of these techniques are used daily in veterinary practice.

Parallel technique<sup>v</sup>: This is where the film is placed parallel to the object being radiographed and perpendicular to the beam. This is how standard (large) films are taken. This gives the most accurate image. Unfortunately this is only useful in the lower cheek teeth in the dog and cat. This is due to the fact that these patients don't have an arched palate. The film cannot be placed parallel to the tooth roots because of the palate's interference. Therefore this technique is not always possible.

Bisecting Angle Technique<sup>vi</sup>: This is the most common type of dental radiograph taken in veterinary patients. This uses the theory of equilateral triangles to create an image that accurately represents the tooth in question. To utilize this technique, the film is placed as parallel as possible to the tooth root. Then the angle between the tooth root and film is measured. This angle is cut in half (bisected) and the beam placed perpendicular to this angle. This gives the most accurate representation of the root.

If this angle is incorrect, the radiographic image will be distorted. This is because the x-ray beam will create an image that is longer or shorter than the object imaged. The best way to visualize this is to think of a building and the sun. The building will create a 90 degree (right) angle to the ground. The bisecting angle in this case is 45 degrees to the ground.

Early and late in the day, the sun is at an acute angle to the building and casts a long shadow. In radiology this occurs when the angle of the beam to the object is too small and is known as elongation. At some point in the late morning and early afternoon, the sun is at a 45 degree angle to the building, which is the bisecting angle. This gives an accurate representation of the building height. As the sun continues up in the sky, the shadow shortens. This occurs in veterinary radiology when the angle is too great and is known as foreshortening. Finally, at noon, the sun is straight up from the building, which gives no shadow.

#### **Step 4: Setting the exposure**

If you are utilizing the computer controlled system, set the buttons for the species, size of the patient, and tooth to be imaged. A common mistake made by many practitioners is that they try to set the specific tooth being imaged for cats. For cats, it is one setting for the entire maxillary (upper) arcade and one for the mandibular (lower) arcade. If you press a particular tooth, it will change back to a dog setting and it will be too dark.

If you have correctly set the machine and the image is incorrectly exposed, the easiest way to adjust is to change the *f* setting. By pressing this button, you will see the numbers go up on both sides. The one on the left is the *f* number and the one on the right is the exposure time. If you continue to press the button it will continue to increase the exposure until you reach 9 when it will markedly lower and the *f* number will go back to 1. If the radiograph is overexposed (too dark) lower the *f* number by 1. If it is underexposed (too light) increase the number by 1. Continue this process until you have the film that you want. Generally, the *f* number will be the same for all radiographs once you have discovered the correct setting for your machine start at that number in future sessions.

If you are using a machine where you set the exposure manually, you will need to set up a technique chart similar to one for a standard (large) unit. The good news is that there is only one variable that needs to be adjusted. A sample chart is provided (table 1), you can start with this and adjust to your individual machine.

### **Step 5: Exposing the radiograph**

Dental radiograph machines have a hand held switch to expose the radiograph. If it is possible, leave the room prior to exposing the radiograph. If it is not, stand at least 6 feet away at a 90 to 130 degree angle to the primary beam (meaning to the side or back of the tube head, not in front or behind). Once everything is set, press the button. It is important to remember, that these switches are “dead man’s”. This means if you let up during the exposure, it will stop the production of x-ray beams. On a standard unit, this will make a light radiograph, on a computer controlled one it will give an error message and you will need to start over. Make sure you hold the button down until the machine stops beeping.

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<sup>i</sup> Thrall DE: Textbook of Veterinary Diagnostic Radiology, third edition. Philadelphia, Saunders, 1998, P. 5-16.

<sup>ii</sup> Wiggs R and Lobprise H: Dental and Oral Radiology. In Veterinary Dentistry, Principals and Practice. Philadelphia, Lippincott – Raven, 1997, P. 146-148.

<sup>iii</sup> Oakes A: Radiology Techniques. In An Atlas of Veterinary Dental Radiology. Deforge DH and Colmery BH eds., Ames, Iowa State University Press, 2000, P. xxiii.

<sup>iv</sup> Wiggs R and Lobprise H: Dental and Oral Radiology. In Veterinary Dentistry, Principals and Practice. Philadelphia, Lippincott – Raven, 1997, P. 149.

<sup>v</sup> Holmstrom S, Frost P, Eisner E: Dental Radiology. In Veterinary Dental Techniques, Second Edition. Philadelphia, Saunders, 1998, P. 114-115.

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<sup>vi</sup> Mulligan T, Aller S, Williams C: Atlas of Canine and Feline Dental Radiography. Trenton, New Jersey, Veterinary Learning Systems, 1998, P. 17-21.