X-RAY VISION
With correct equipment and practice, all technicians can safely and efficiently produce high-quality dental radiographs.

Liane K. Shaw, BS, RVT
is the diagnostic imaging instructional technologist at Purdue University. She earned an associate’s degree and bachelor’s degree in applied science at the Veterinary Technology Program at Purdue University. She then worked at a private practice for 7 years and was a supervisor for the clinic before coming back to Purdue University to pursue her love for teaching. In 2011 she received an award for teaching excellence from Purdue University and Elanco Animal Health. She has spoken at conferences about dental radiography and digital radiography. In 2017 she coauthored 2 articles on radiology positioning published in Today’s Veterinary Technician.
Dental radiographs can be frustrating, time consuming, and overwhelming. However, if radiography is not performed, 50% of tooth anatomy will be left undiagnosed. Most veterinary dentists believe full-mouth intraoral dental radiographs should be routine with every cleaning, allowing the unexposed abnormality to be revealed. If dental radiographs are not taken, dental disease cannot be adequately diagnosed, monitored, and treated. Technicians must produce good-quality radiographs in order for a correct diagnosis to be given. To ensure a proper diagnosis, dental radiographs should include the entire crown and roots of the tooth or teeth of interest. This article will help veterinary team members refresh themselves about common dental radiography procedures.

SAFETY

Safety is always important when it comes to the production of x-rays. Radiation exposure in dental radiography is comparatively low, but one should always practice ALARA (as low as reasonably achievable). All personnel must be aware of their own radiation exposure and take all precautions necessary to reduce exposure. Staff should leave the room whenever possible. Radiation exposure can be minimized by using three simple methods: distance, shielding, and exposure time. In dental radiography, distance is the most helpful method. The inverse square law states that the x-ray beam intensity decreases to one fourth if the distance from the primary beam is doubled.
Staff should remain at a maximum distance from the x-ray beam to reduce exposure to scatter. If staff cannot be at least 6 feet from the primary beam, they should try to use approved 0.5-mm lead shielding. This shielding can consist of lead aprons that include a thyroid shield or a full-length lead shield. Minimize the length of exposure by using the shortest exposure time required to get a diagnostic image, and strive to achieve the best diagnostic image in the fewest exposures possible. Exposure will be minimized if all personnel practice ALARA. No radiation exposure is risk-free.

**EQUIPMENT**

Dental x-ray units (FIGURE 1) are most commonly purchased and used to produce dental radiographs. These units are portable or wall mounted. They have flexible arms that allow for optimal positioning and keep exposure to a minimum. These units often have fixed or preset peak kilovoltage (kVp) and milliamperage-seconds (mAs) and a variable exposure time. The time is adjusted to accommodate the thickness of the area of interest being imaged. These units often have predetermined angles marked beside the tube head to help with dental radiography positioning. This angle meter is typically set up to with the angle perpendicular to the ground at zero degrees. However, some models have the angle meter set to 90 degrees when perpendicular to the ground or floor. In this article, we assume that all angle meters on dental units are set to be 0 degrees when perpendicular to the ground.

Veterinary medical x-ray units can also be used to produce dental radiographs. These units can be used only if the tube head and the focal film distance are adjustable (FIGURE 2). Focal film distance (FFD) or source image distance (SID) is the distance from the tube head to the recording surface, film, or receptor. Try to maintain a short FFD/SID to obtain a sharp image. The tube head must be maneuverable into multiple different planes to obtain diagnostic views. The drawback to this unit is that it may already be in use and is not portable; thus, using it to produce dental radiographs is inefficient. Transferring an anesthetized patient to another room can often be hectic. If a general radiology unit is used, a technique involving 60 to 85 kVp, about 10 mA, and an FFD/SID of 12 to 16 inches can be used.

**RECORDING THE IMAGE**

There are several ways to record dental images. Dental film is a nonscreen film that is composed of many layers. Dental film comes in many sizes, ranging from small (size 0) to large (size 4). Sizes 2 and 4 are commonly used in veterinary dentistry radiography. When whole quadrants or large patients are imaged, size 4 film should be used. Size 2 film is used for imaging individual teeth. No matter what size film is used, it is important to ensure that the size of film is sufficient for
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obtaining an image of the entire tooth, root to crown. Remember, almost half of the anatomy of the tooth is hidden under the gum line. Dental films can be processed by using a light proof chairside or tableside processor, or in an automatic processor. Films must be contained in a special processing mount before being placed in the automatic processor. No matter which method of processing is used, the technician must pay close attention to the final product. Improper processing can lead to many avoidable repeated radiographs.

Computed (CR) and direct (DR) image recording sensors are also available. Digital dental sensors allow technicians to be more efficient and proficient at imaging while greatly reducing exposure. The sensors also allow for easier patient identification and interpretation. The indirect sensor (CR) uses a reusable photostimulable phosphor plate that is exposed to x-rays; the image is then converted to a digital image by a computer. This phosphor plate comes in the same sizes as traditional film. The plates degrade over time, and permanent artifacts can occur. DR gives an immediate digital image by converting x-rays to light energy and then into an electronic signal. This signal is sent directly to a computer screen for viewing in about 20 seconds. One drawback to DR is that the most affordable sensor is available only in a size 2; as a result, multiple views must be obtained for large teeth. These views can be rostral and caudal views or root and crown views. In switching to digital imaging, usage, price, radiation safety, and film storage should be considered.

VIEWS

A full mouth series consists of rostral maxillary and mandibular views, right and left maxillary views, and right and left mandibular views. The rostral maxillary and mandibular views should include the canine teeth. Maxillary canine teeth are imaged in separate oblique views to prevent superimposition of the first and second premolars upon the canine tooth roots. Additional images or views may be needed for specific species or dental abnormalities.

POSITIONING

Parallel technique and bisecting angles are the two most common positioning techniques used in veterinary dental radiology. Parallel technique is used for imaging the caudal mandibular premolars and molars, and the bisecting angle technique is used for all maxillary teeth and the rostral mandibular teeth. The sensor/film must be correctly placed and stable. Digital sensors are thicker and less pliable than film, and some creativity is often required to hold the sensor in a specific location. CR sensors are flimsy and very sensitive to pressure; thus, positioning devices are needed to ensure that the sensor is not damaged. Sensor/film positioning devices should be used to ensure proper placement and safety of the sensor. Examples include the following:

- Small rubber-coated dental wedges or mouth props
- Children’s playdough or clay placed inside a plastic bag
- Small plastic-coated foam hair rollers
- Disposable gauze sponges or paper towel sheets
The four Ps of dental radiography are used to ensure a high success rate: position of skull, placement of sensor/film, point of tube head, and production of radiograph.

Parallel Technique

One method of positioning a patient for parallel technique involves placing the patient in lateral recumbency with the side of interest facing up. The film/sensor will be placed intraorally on the lingual surface of the teeth. Film/sensor positioning aids should be used to keep the film/sensor in place. The film/sensor must be as parallel to the tooth of interest as possible. The sensor/film must also be placed so that the entire tooth of interest is contained within it, crown to root. The tube head or x-ray machine is then set at a 90-degree angle, or perpendicular to the film. This technique is simple but has limited use because of anatomic restrictions in the rest of the mouth (FIGURE 5).

Bisecting Angle Technique

To avoid image distortions, all other views can be acquired by using the bisecting angle technique. This technique is challenging to learn but can be easily mastered with practice. An analogy to help better understand or visualize the bisecting angle is to imagine a person standing on a bright sunny day. If the sun is high, the resulting shadow will be short. If the sun is setting, the shadow will be long. When the sun is at a moderate angle in the sky, the resulting shadow’s length will approximate the person’s height. This would be considered the bisecting angle.
In the technique discussed here, the patient is placed in sternal recumbency to obtain views of the maxillary teeth and in dorsal recumbency to obtain views of the mandibular teeth. The sensor/film should be placed intraorally beneath the area of interest, as if the patient is biting on it. Imagine a line parallel to the plane of the sensor/film, and another line parallel to the plane of the tooth from crown to root. These two lines will intersect, forming an angle. Divide (bisect) this angle in half and aim the tube head or primary beam perpendicular to this imaginary line,\(^3\) centering over the tooth of interest (FIGURES 6–8).

If the image is elongated, the x-ray beam has been aimed too parallel to the sensor/film (FIGURES 9 AND 10).

However, if the image is shortened, the beam has been aimed too perpendicular to the sensor/film (FIGURES 11 AND 12). A radiograph is useful only if the information on it is accurate.

Imaging Specific Teeth

To image the rostral mandibular incisors and canine teeth, the patient is placed in dorsal recumbency. Ensure that the palate is parallel to the table. Place the sensor/film between the teeth and tongue in landscape or portrait orientation, depending on the size of the patient. The use of a positioning aid is always recommended. If the tongue becomes an obstacle, the sensor/film may be placed below the tongue. This soft tissue opacity will not interfere with radiographic interpretation. Point the tube head at the bisecting angle line, approximately 15 to 25 degrees, and center the beam over the tooth of interest. If the root apices are not captured, place the sensor/film behind the canine teeth and move the tube head caudally without changing the bisecting angle to capture root tips.

Because of the mandibular symphysis, the bisecting angle technique is used to produce radiographs of the
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rostral mandibular premolars. The patient is placed in dorsal recumbency with the skull parallel to the table. The sensor or film will be placed parallel to the table between the maxillary and mandibular premolars. The tooth of interest should be centered on the sensor. Aim the tube head perpendicular to the bisecting angle line and center it over the premolars of interest. The angle will be approximately 30 to 45 degrees.

To obtain radiographs of the caudal right or left mandibular teeth, the patient is placed in lateral recumbency with the side to be imaged facing up. To ensure that the skull is parallel to the table, place padding under the c-spine and beneath the tip of the nose. The sensor or film should be placed intraorally parallel to the mandible and tooth of interest on the lingual side. Depending on the size of the area of interest, one can place the film in portrait or landscape orientation. When the caudal molars are being radiographed, the sensor/film is sometimes placed too deep into the soft tissue. Place the sensor/film even with the crowns. Aim the tube head perpendicular to the tooth of interest and sensor/film and produce the radiograph. Try to include the entire tooth of interest in one radiograph, if possible.

To image the rostral maxillary incisors and canine teeth, place the patient in sternal recumbency. Padding is typically needed at the base of the neck to ensure that the skull is parallel to the table. Place the sensor/film in portrait or landscape orientation between the maxillary and mandibular incisors. A positioning aid is recommended to help hold the sensor/film in place. Determine the bisecting angle line and aim the tube head perpendicular to it, centering over the maxillary incisors. The tube head is typically at a 20- to 30-degree angle for this image. If the radiograph produced does not include all of the incisor and canine roots, move the sensor/film and tube head behind the canine teeth crowns and produce a second radiograph.

To achieve oblique radiographs of the maxillary canine teeth, place the patient in sternal recumbency. Position the skull with padding so that it is parallel to the floor. The tip of the crown of the canine tooth should be placed at the corner of the sensor/film. Angle the film intraorally and caudally toward the opposite arcade to capture the root apex. Use a positioning aid as needed to keep the sensor/film in place. Aim the tube head perpendicular to the bisecting angle, centering over the canine tooth from a rostrolateral approach. The tube head should be at a 45-degree angle to the sensor/film. Use a film/sensor large enough to capture images of both the crown and the root. Alternatively, separate cranial and caudal views can be obtained. To obtain a caudal view, push the sensor caudal behind the crown of the canine tooth and recenter the tube head over the root.

To image the right or left maxillary premolars, the patient should be in sternal recumbency. The sensor/film should be placed intraorally beneath the maxillary teeth of interest. It will appear that the patient is biting on the sensor/film. Positioning devices are needed to ensure that the sensor/film is parallel to the table. Determine the bisecting angle and aim the tube head perpendicular to it, centering over the tooth or teeth of interest from a lateral direction. In dogs, the tube head should be at a 30- to 45-degree angle. Cats require a steeper angle (20 to 30 degrees) to minimize superimposition of the zygomatic arch. Three rooted teeth often require a second view in order to visualize both mesial roots. This is accomplished by rotating the tube head rostrally while maintaining the bisecting angle.

The four Ps of dental radiography are used to ensure a high success rate: position of skull, placement of sensor/film, point of tube head, and production of radiograph.
CONCLUSION

With correct equipment and practice, all technicians can safely and efficiently produce high-quality dental radiographs. Our goal as technicians is to allow the patient to receive an accurate diagnosis and appropriate treatment. Improper positioning or processing can lead to misdiagnosis. Hands-on labs or practice is an excellent investment and will greatly improve the learning curve. After the positioning techniques described here are mastered, progressing to obtain all dental radiographs in lateral recumbency may increase patient safety and decrease anesthesia time. A radiograph is only as useful as the information it depicts. For a sample positioning chart, visit todaysveterinarynurse.com/clinic-resources to download a PDF of the chart. And last, personal safety should never be jeopardized to achieve a diagnostic radiograph.¹ 

References