Radiology is a vital tool in veterinary dentistry assisting in diagnosis, treatment planning, and monitoring of oral disease. Diagnostically, being able to assess normal anatomy helps to determine if abnormalities exist, including variations in development (missing or aberrant teeth) or acquired diseases that may affect the bone and tooth structure (CMO, hyperparathyroidism, neoplasia). When determining the possible treatment for problems such as feline cervical line lesions, endodontically compromised teeth and periodontal disease, radiology can help the practitioner make a more accurate assessment. Preoperative radiographs can help monitor extractions by revealing abnormal root structures, impacted teeth, tooth resorption and ankylosed roots. Post-operative films check treatment success. Endodontics requires several films during the procedure to evaluate routine treatment and reveal complications.

**Basics of equipment**

**Radiographic unit**
The most commonly used x-ray generator is a standard dental model, which is either wall-mounted or supported by a mobile stand. There are also hand-held units available for greater ease in transportation or use in multiple sites. Staff should minimize their exposure by standing at least 6 feet from the tube head and always at an angle of 90 to 135 degrees from the path of the primary beam.

**Films**

Intraoral films provide isolation of a specific tooth with excellent detail, with a non-screen, double-coated emulsion film. The No.2 periapical film is the most commonly used, and is similar in size to most digital sensors. Occlusal films (No.4.) are 2 1/4 X 3 inches in size and often used for imaging the incisal areas, to include the canines of larger dogs, and can be useful for nasal imaging. A raised dot imprinted on the film and packet indicates the side that should face the X-ray tube, placing the concave "dimple" away from the tube. Once developed, this dot helps determine the orientation and identification of the teeth. The film is encased in an inner black paper sheet with a layer of lead foil on the backside that reduces backscatter from deeper oral tissues, all in a plastic or paper cover. These films can be hand developed in small containers in a dark room, using a chairside developer, or an automatic developer.

**Direct digital**

For convenience, increased use and decreased patient anesthetic time, investing in a digital dental system often pays for itself in a matter of months, and greatly increases the learning curve for new users. While the sensors are not inexpensive, being able to immediately see the image on the computer screen is of great benefit for both diagnostic purposes and to be able to adjust the angulation or technique to get a reasonable image. A downside to direct digital is the single size (No.2) of the sensor.

**Indirect digital**

As a compromise between standard films and direct digital, indirect digital radiography may be accomplished using phosphor plates that are photostimulatable. The phosphorus sensor uses an image plate that can be reused (the outer sleeve is replaced), then the plate is placed in a scanner, so the image can be transferred to a computer. There are more steps with the indirect method and it takes longer than the direct method, but varying sizes of plates can be utilized.

**Technique**

There are many ways to teach and take dental radiographs; the author’s preference is to have the patient in lateral recumbency and slightly adjust the head position using towels, depending on the image needed. Others prefer dorsal and ventral recumbency for taking radiographs - determine what works best for you and your staff

**Parallel**

While a parallel technique (film and object parallel with x-beam perpendicular) would be ideal to minimize distortion, most areas of the oral cavity do not lend themselves easily to this positioning. The only region where the film can be placed parallel to the teeth is that of the mandibular premolars and molars, with a corner of the film pressing into the intermandibular space. The most mesial (rostral) roots and teeth may not be visible on this view, as the film may be limited by the mandibular symphysis, but aiming the radiographic beam from a slightly rostral oblique position may allow these roots to be imaged.

**Bisecting angle technique**

For the rest of the teeth in the oral cavity, a parallel positioning is not possible, so, a film is placed as close to a parallel plane to the object (root or tooth) as possible. Remember to place the film so the roots will be imaged, not necessarily the crown. One option is to use a bisecting angle technique for these films by aiming the beam at a line that bisects the angle formed by the long axis of the object (tooth) and the film.
Modified technique
Another way of determining beam position is to first line up the beam (or similar object such as a 2-inch roll of tape) perpendicular to the film. This would result in an image that is too short (shadow of a tree at noon). Next, line up the beam perpendicular to the root (tooth); this image would be too long (shadow of a tree at daybreak). Then, split the difference between these two positions, and the resulting image will be approximately the same size as the object, thus minimizing the distortion (and the beam will be perpendicular to that bisecting line mentioned earlier). Helpful devices, such as connecting two tongue depressors with a pushpin, and using a roll of tape to invisualize where the beam will travel, can help you determine the two positions (perpendicular to film; perpendicular to tooth), so you can aim the beam halfway between the two. This perspective will also help you make appropriate adjustments to an image; if you want to make the image shorter, move the beam to a position more perpendicular to the film.

Challenging radiographs – the cat quick 6
- With the cat in lateral recumbency (e.g. – left side down), take the first image of the mandibular premolars and molar with a parallel technique.
  - If the mesial (rostral) root of the mandibular third premolar does not show, adjust the xray head further ventral and forward
- Take an image of the lower canines and incisors: roll the tongue back into the pharyngeal area to keep the sensor in place better; use the modified technique
- Take an image of the upper canine and incisors with the sensor ‘wide’ across the palate
  - If you need to isolate the right canine tooth apex better, come slightly off midline
  - Take an image of the maxillary premolars
  - Place the sensor up against the palate
  - Using a tape roll, visualize where the beam would be, if aimed directly perpendicular to the teeth: you will not be coming directly laterally to the maxilla, but slightly from in front
  - Then visualize where the beam would be perpendicular to the film
  - Split the difference
  - The zygomatic arch will always be in the way – if you elongate the image by moving the xray beam more perpendicular to the teeth, the arch ‘moves’ a little more out of the way.
- Using a clear feline mouth gag (cut part of a tuberculin syringe); place the sensor under the head on the left side (extraoral); the left maxillary premolars will be placed nearly flat on the sensor in this position.
  - Using the tape roll, and angled from the back of the head, look across the arch at an oblique/angle, until you see the palatal surfaces of the left maxillary premolars without the right premolars superimposed over them
    - Make sure the sensor is placed far enough forward and dorsal that the angled beam will go through the teeth and hit the plate.
- 5 of the 6 films are done!
  - Adjust the cat to left lateral recumbency and take the left mandibular premolars

Challenging dog radiographs
- Maxillary incisors – in most dogs with a normal head shape, then ventral portion of the nares will be lined up with the base of the xray cone when positioned
- Maxillary canine apex – palpate where the apex is positioned by running your finger up the buccal jugae to the tip (it is usually somewhere over the second premolar
  - Place the sensor centered at the maxillary second premolar
  - Adjust the xray beam from midline to a slight oblique so the canine is not superimposed over the premolars in the image; make sure it is centered on the spot where you palpated the canine apex
- Maxillary molars – with a skull or model, observe how the molars are in a different ‘line’ than the premolars
  - Place the sensor in the mouth lined up with the two molars (usually angled in a palatal direction)
  - Aim the beam almost directly onto the sensor (just a slight adjustment)
- Mandibular canines
  - If you place the sensor across both lower second premolars and aim the beam perpendicular to the sensor, you will have both canine apices for good comparison
- Mandibular premolars
  - Since the symphysis restricts the sensor from going far enough forward to get a true parallel image of the first and second premolars, adjust the beam to come from in front of and below the teeth to ‘push’ them onto the image (or take it extraorally)
- Brachcephalic dogs
Troubleshooting radiographs

- Teeth are too long, or the apex is not on the film
  - Place the sensor deeper into the palate – you want to see the roots, not the crown
  - Adjust the beam to be more perpendicular to the film – ‘shortens’ the teeth

- Teeth are too short
  - Adjust the beam to be more perpendicular to the tooth – ‘elongates’ the teeth

- Image shows unexpected bone loss (and crowns are burnt out)
  - Decrease time of exposure; if at lowest time, move xray cone an inch or two away from object

- Use extraoral shots as is done for cats