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Information and insights into radiography using your IDEXX Digital Imaging System

Digital Intraoral Radiology— Standard of Care for Dental Diagnostics

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Standard of care is a diagnostic and treatment process that a clinician should follow for a certain type of patient, illness, or clinical circumstance.¹ The companion animal patient receiving dental care is a prime candidate for intraoral dental imaging, which is rapidly evolving as a standard of care. The crowns of teeth can be cleaned and polished without seeing radiographic images below the gingiva, but “dentistry” cannot be performed, as it should be. Intraoral radiographs are essential to provide quality dental diagnostics and therapy.

How can diagnostic full-mouth survey films be obtained? Skull films exposed with a full body x-ray unit to evaluate dental structures are not usually diagnostic due to superimposition of one arch upon the other. Intraoral films exposed with a dedicated dental unit provide the needed information.

The individual film(s) can be processed either manually in hand tanks or with an automatic film processor.

Alternately, a digital sensor instead of film may be exposed, allowing the images to be captured and viewed directly on a computer screen. Digital dental imaging is easier, more economical, and in many ways more diagnostic than the “analog” film methodology.

Benefits of Using Digital Radiology In Veterinary Dentistry

Time saver—With a finite amount of time in each day, veterinarians and their staffs strive to perform tasks as efficiently as possible. Once a practice has agreed that intraoral radiology is critical to perform dentistry, frustration sets in trying to figure out how to

expose and process films properly. Digital radiology decreases the dental radiology learning curve exponentially through efficient staff teaching tube head/sensor position and instant results received without timely film processing.

Money saver—Intraoral digital systems cost \$6,000–\$18,000 (U.S.) in addition to the dental x-ray generator and computer. According to an article in *Dental Economics*, the real cost for each processed analog film is \$1.18.² With most studies involving at least 10 films, out of pocket expenses can easily add up.

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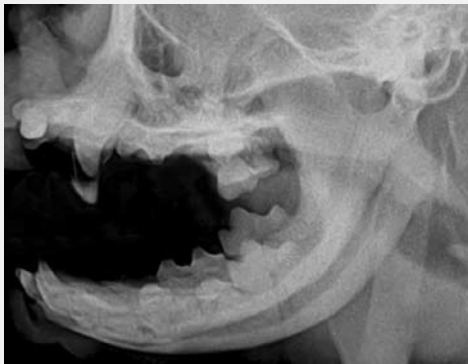


Figure 1. Superimposition of teeth on skull film.

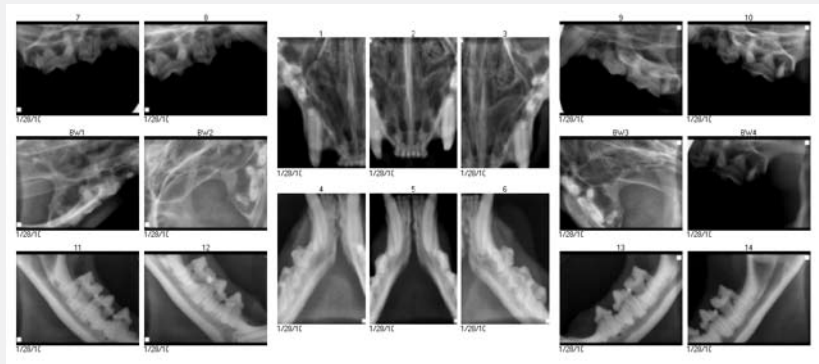


Figure 2. Digital oral survey compilation.



Figure 3. Fractured right maxillary canine and gingival inflammation.



Figure 4. Intraoral films revealed loss of maxilla detail in addition to the complicated crown fracture; biopsy confirmed round cell sarcoma.

As with digital cameras, once the unit is paid for there are virtually no additional expenses, compared to the ongoing film, processing, and storage expenses of analog technology. If only two oral surveys (6–14 films) are taken per practice per day, the digital system will be paid off within 18 months, not including the additional income generated through therapy performed based on radiographic findings. The real practice savings result from reduced staff and anesthesia time. Generally, a full-mouth intraoral survey takes 5–10 minutes to accomplish, compared to at least 30 minutes with analog films. Additionally, the time saved through instant retakes needed to view

possible dental lesions from different angles makes digital imaging indispensable to the veterinarian practicing dentistry. Decreasing the staff and anesthetic time by 20 minutes per patient adds up to thousands of dollars saved yearly in the typical practice.

Good medicine—Radiology is essential to perform thorough dental care as 60% of the tooth lies below the gum line. Without radiology, other than a periodontal probe, there is little left to evaluate the periodontal and endodontic condition of our patients.

It's simply more rewarding to view enlarged digital images within seconds on a large

monitor than to wait at least five minutes to observe a small film on a light box. Electronic processing and enhancement allows more diagnostic information to be extracted from the image, as well. Digital images are easily saved in a variety of formats for insertion into the client file, to be emailed for immediate consultation with results often returned while the patient is still anesthetized, or used in a report given to the client. Archived image storage on the computer's hard drive is automatic and requires no physical space or film sorting time on the part of the technician.

Additional Advantages of Digital Intraoral Radiology

- 1. Lower radiation dosage**—Digital systems require up to 80% less dosage than D-Speed film.
- 2. Faster imaging**—Direct, wired digital systems provide immediate results without waiting for film to be developed or plates to be scanned.
- 3. Electronic storage**—Allows faster access and heightened record safety at lower cost and reduced physical space requirements when proper electronic backup procedures are followed.
- 4. Electronic referrals**—Files may be transmitted electronically for additional opinions when digitally stored images are available.
- 5. Less time needed for retakes**—Because the image can be adjusted on the computer, there is less of a need to re-expose a radiograph that may have been over- or underexposed.

What Are the Intraoral Digital Capture Formats?

Digital technologies available for dental imaging fall into two basic categories: photo-sensitive phosphor (PSP) plates and direct-imaging sensors.

PSP technology utilizes an x-ray-sensitive plate that replaces film. It is exposed by the x-ray unit and placed into a scanning device, which records the latent image and converts it to a digital file in a computer within 45

seconds. While the plate is relatively rugged with fewer size restrictions, the equipment is bulky. The plates need replacing after 50–500 exposures, depending on the manufacturer, at a cost of approximately \$25 (U.S.). Phosphor sensors and plates are available through All Pro Imaging.

Direct-imaging sensors are wired directly or employ wireless technology to communicate with a computer. The image can be viewed onscreen within seconds without additional handling or processing. The original sensors used a charge-coupled device (CCD) combined with a scintillator to produce an instant image. The process was termed RadioVisioGraphy (RVG). RVG was designed for “operative radiology” in human dentistry rather than to replace the full-mouth series of film images. Over the past two decades, there have been five additional versions of the RVG—the most recent system is based upon a complementary metal oxide semiconductor (CMOS). CMOS produces high-efficiency, low-noise images, which are then digitized and transmitted to a computer via a standard USB port. Imageworks, Bio-Ray Dental Systems, XDR, Progeny by MIDMARK, Sopix and Schick Technologies represent popular system manufacturers on the market.

What Will You Need to Get Started or Convert to Digital Dental Radiology?

A dental x-ray unit is required to expose the sensor. Traditional AC units are adequate but if the veterinarian is purchasing all new equipment, DC generators produce a homogeneous x-ray beam which works best with the sensor. Since the amount of radiation necessary to produce digital images are less than traditional film, old dental x-ray units may need to be replaced.

A desktop, tablet, or laptop computer in the treatment area captures and displays the images. The sensor is portable between treatment tables, but must be able to attach to a USB port easily unless a wireless system (e.g., Schick Technologies) is used. Computers have USB ports in back or on the front. If the computer is located inside a cabinet, USB-powered hubs with six-foot wires allow the

USB outlet to be placed in a more accessible location.

The digital sensor replaces film in the patient’s mouth. Sensors are available in three sizes similar to film numbers: 0, 1, 2 (check with manufacturers for specific availability). Phosphor plates are available in sizes 0,1, 2, 4, and 6. Parallel and bisecting angle technique is used to position the sensor properly. The operator chooses the tooth or quadrant to be exposed from software downloaded into the computer. Images will appear on the screen within seconds.

Image quality is equivalent to traditional dental films. The software allows a variety of options for enhancing and manipulating the image for greater diagnostic value. The tools used most often include enlargement, auto contrast, grayscale resolution, spotlight features, inversion of colors, and measurement rulers.

Which System?

There are many dental digital vendors. It sometimes is difficult to compare apples to apples. One criterion common to all systems is the achieved resolution based upon line pair discrimination (lp/mm). Differences in lp/mm affect image quality as the image size is increased. The human eye views 10 line pairs per millimeter. Other parameters to consider are sensor size, numbers of pixels in the sensor, pixel size, active image area, and readout time.

Reviewing the systems available today, a great many of them mention various aspects, such as pixel size and line pair resolution, as a way to quantitatively assess the quality of the product. These, along with other quantitative values quoted by different companies, may either apply to the technology’s raw format or to images that are not displayed for diagnostic purposes.

As such, it’s best to base your purchasing decision on the purest form of assessment possible—the quality of the images themselves. Ideally, a live demonstration in your office, using your own equipment, is the best test. If you do not have your own equipment, ask the sales representative to

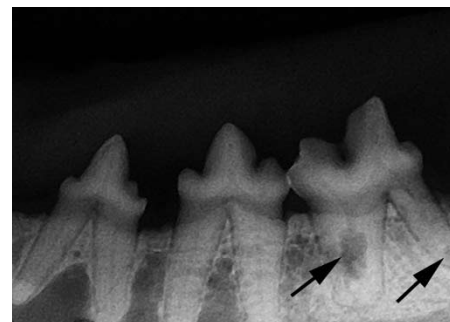


Figure 5. Intraoral films revealed internal resorption of the first molar, necessitating extraction.

provide you with names of existing users who you can contact to obtain images to examine.

Important Considerations When Evaluating Intraoral Digital Sensors

Active Area—The available area of a sensor to which data (x-rays) can be actively measured. This is measured as the horizontal dimension in millimeters (mm). The active area is limited by the size of the pixel.

Dynamic Range—A ratio of the largest output of a device divided by its smallest output, measured in decibels (dB). The dynamic range indicates what output the system is capable of producing. The larger the dB number, the better the image.

Film Size Equivalent—The size of the sensor and resulting image in relation to traditional film-based x-ray systems available to the dentistry profession.

Pixel Matrix—A tool that multiplies the number of pixel elements in the horizontal by the number of pixel elements in the vertical, resulting in the total number of pixels displayed.

Pixel Size—The relative size of the pixel to be displayed, as measured in microns.

Readout Time—The amount of time from which the sensor receives the input (x-ray) to the time it has completed transmission of the data to the computer processor, measured in seconds.

Resolution—A measurement, noted in line pairs (lp), that describes a system’s ability to capture detail. Electronics industry accepted methodology and protocols utilize the direct calculation of the known spacing of the

pixel elements shown by the manufacturers' documents and production criteria.

Sensor Dimensions—The external dimension measurement of the variously sized sensors, measured in millimeters.

Signal-to-Noise Ratio—The ratio of signal coming out of a sensor with no image present (noise) to the maximum signal coming out of a sensor without saturation (the most intense image).

Should I first purchase a film-based system and then convert?

At one time the general recommendation was to get used to hand-processed film, then purchase an automatic film processor when the dental practice was busy enough to

support one, and, finally, convert to digital if warranted. Now it makes more sense to cut out the film and processing steps. Of those intending to buy a camera now, most would not buy a film camera to practice with, even though it may be less expensive, initially. The same reasoning applies to dental radiology—digital makes more sense.

Intraoral digital dental radiology makes sense on all levels. Through this user-friendly, economical diagnostic tool you can provide the best dental and diagnostic care for your patients.



Figure 6. Calculus and plaque on the buccal surface of the right maxillary first molar,

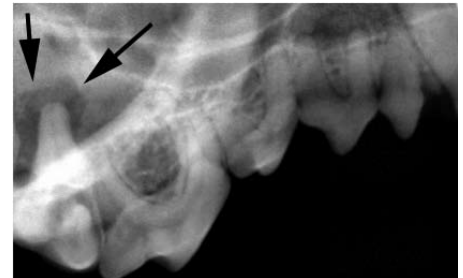


Figure 7. Intraoral film revealing periapical disease, necessitating extraction.

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2. Feuerstein P. Digital radiography. *Dental Economics*. 2005;95(2):98.

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