

Oral Radiology for Practitioners

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Oral radiology is an important but often neglected component in the successful practice of veterinary medicine today.

Oral radiology is a vital diagnostic tool in veterinary dentistry. It allows the visualisation of tooth structure below the gingiva, without the superimposition of the opposite jaw and other anatomical structures which may interfere with reaching a diagnosis. It offers an assessment of the periodontal and pulpal health of the tooth as well as any bony/soft tissue pathology that may be present.

It is divided into intra-oral and extra-oral radiography and can utilise either non-screen dental films or screen cassette type films. The lecture will mainly discuss the use of non screen dental films in oral radiology. Extra-oral radiography poses problems of anatomic superimposition which interferes with radiographic interpretation.

However, extra-oral radiographic views are helpful when looking at the temporomandibular joint and bony abnormalities of the maxilla and mandible.

Some of the indications for dental radiography include:

- 1 Periodontal disease- assessment of bone levels, type of bone loss, combined periodontal-endodontic lesions, success or failure of periodontal therapy.
- 2 Endodontic disease including periapical pathology, pulp exposures and draining fistulae.
- 3 Pathology of the oral soft and hard tissues including tumours, fractures.
- 4 Temporomandibular joint dysfunction.
- 5 Crown/root pathology including odontoclastic resorptive lesions, crown or root fractures, extra roots, dilacerated roots.
- 6 Pre/post tooth extraction.
- 7 Root canal therapy.
- 8 Oligodontia/supernumerary teeth especially in breeds with a family history of missing or extra permanent teeth.
- 9 An assessment of tooth development and chronological/dental age of the animal.

EQUIPMENT

- A DENTAL X-RAY MACHINE
- B DENTAL FILM
- C FILM PROCESSING

To perform high quality veterinary dentistry, the use of a dental X-ray machine and dental film is preferable. However, practices without dental X-ray machines can still take high quality dental radiographs with a standard X-ray machine and intra-oral dental film.

A. Dental X-ray machine:

Dental X-ray machines are usually wall mounted or mobile units that can be wheeled from room to room. Wall mounted units with the longest possible extension arm are ideal for veterinary dentistry.

The unit can be positioned next to the dental operative and when not in use, folded against the wall to free up space and lessen any risk of damage to the unit. The units usually have fixed kilovolts peak (KVp) often between 50 and 90 KVp.

The milliamperes are also usually fixed (5-20 mA) so that the only variable is the duration of the exposure. The timer can be either an electronic or a countdown manual timer and newer machines often have preset times for each tooth type in dental arches. The timer button is of a dead man type so that positive pressure must be maintained on the button during the entire exposure.



Dental X-ray machine - University of Melbourne.

Any dental X-ray machine can be used with computerised digital systems (CDS) of which some use a sensor (charged coupled device or CCD) to pick up the image. The CCD then transfers the image to a computer and after the interpretation of the image (with specific software), the radiographic image appears on the monitor within seconds. This saves on time and developing/fixing costs as well as delivering a 95% reduction in radiation exposure to the patient (more important in human dentistry) compared to conventional dental radiography. However the contrast of the image still appears better in conventional radiography with dental films, although digital radiographic contrast is improving all the time. The downside is the cost, with CDS's costing well above \$10,000 AUD.

Dental X-ray units cost around the \$6000 AUD. Second hand dental X-ray machines are available and usually can be purchased for as little as \$1200 AUD. If you intend to increase the quality and amount of dentistry that you do in your practice, a dental X-ray machine is an ideal purchase and will pay for itself many times over in the first year of usage.

Most dental X-ray machines are long collimator "cone" units (positioning- indicating device or PID). The cones are usually lead-lined to allow for more concentrated and near parallel x-rays. These units have a focal-film distance (FFD) of between 20- 40 cm. Scatter of X-rays can be reduced further if the FFD is approximately 30 cm. The long cone minimises the amount of scatter and concentrates the beam of X-rays. They also allow the beam to be aimed directly at the area of interest and give greater radiographic detail than conventional X-ray units.

Remember the inverse square law when choosing FFD. This law states that the intensity of radiation required varies inversely with the square of the distance, so that if the FFD

is doubled, with kilovoltage and milliamperage remaining the same, the exposure time needs to be quadrupled to maintain the same exposure. This law becomes important when considering using a standard veterinary X-ray machine usually with a FFD of 100cm. Most units these days can be manoeuvred to reduce the FFD down to a long cone type set up, as well as allowing vertical tilt. Vertical angulation is important when using the bisecting angle technique (see later on).

B. Dental film

Intra-oral dental films are non-screen films made of transparent, flexible, blue-tinted film base coated on both sides with emulsion and secured with an outer protective coating. The films are flexible to a point and will allow the bending of the film when it is placed. The films are marked with a raised dot indicating the tube side of the film.

The emulsion consists of X-ray and light sensitive crystals of silver halide embedded in gelatine that are exposed directly to x-rays. They differ to normal screen film which uses a light-tight cassette with a double emulsion film sandwiched between two intensifying screens. The screens phosphorescent crystals illuminate from direct contact with x-rays and give off light to capture the latent image on the film.

Dental film has no intensifying screens (non-screen) but contains a sheet of lead foil in its packet behind the film. This reduces radiation that would normally be produced by backscatter from the deeper tissues of the oral cavity. The size of the film also means that you radiograph only what is of diagnostic importance to you, thus eliminating the inclusion of unnecessary images that can complicate interpretation.

Dental film has four main components. The film itself is wrapped in black paper to protect it from light exposure. As mentioned before, the back of the film contains lead foil to shield the film from back scatter that may cause fogging. These components are then wrapped in a plastic outer wrap, which is moisture resistant.

Dental film should be stored in a cool, dry place at temperatures between 10- 21 degrees Celsius with humidity no greater than 60%. The film should be stored on end rather than be stacked one on top of each other.

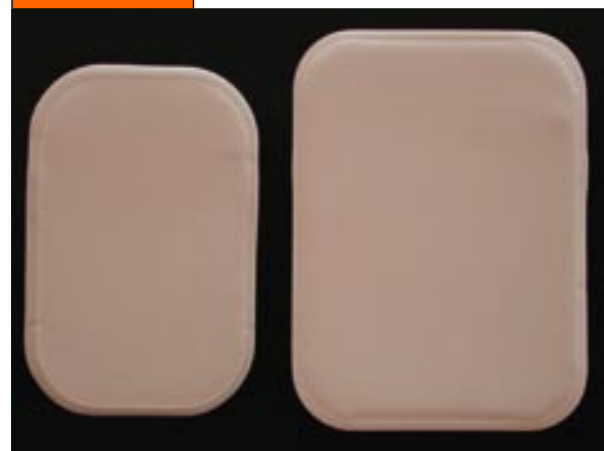
Film speed: Film sensitivity (speed) is a measure of how much radiation is required to produce a certain density in the processed film; the faster the film, the larger the silver halide crystals, the less radiation needed to become exposed. Currently available for dental radiography are the D-speed (ultra-speed), E-speed (Ekta-speed) and more recently F-speed (insight). However the trade off for increased speed is less contrast and detail.

The E-speed film requires one-half the radiation dose of the D-speed film and the newer F-speed film 20% less than the E-speed film. Exposure times for digital radiography are 50-80% shorter than those for E-speed film.

D-speed film is reasonably priced and offers excellent diagnostic quality for veterinary dentistry. **It is commonly used in veterinary dentistry.**

The three useful film sizes often used in veterinary dentistry are No. 0 periapical children's film (Kodak DF54) for cats and toy breeds of dogs, No. 2 periapical adult film (Kodak DF58) for cats and medium size dogs or individual teeth of larger dogs, and No. 4 occlusal film (Kodak DF50) for larger breeds of dogs or for dental surveys including bone pathology/trauma.

NO. 0 FILM	22 x 35 mm
NO. 2 FILM	31 x 41 mm
NO. 4 FILM	57 x 77 mm



Left: No. 0 film, right: No. 2 film.

No. 2 film can be purchased either packaged singly or with two films per packet. In a referral practice, this allows two films to be exposed simultaneously so that an identical film can be forwarded to the referring veterinarian.

C. Film processing

Dental films can be processed in the normal manual way in a dark room. Dental radiograph holders can be purchased to hold individual films or multiple films. To save costs, one can also use the corners of a standard cassette radiograph holder when processing in a dark room. Standard developer/ fixer is acceptable for the processing of dental radiographs. Usual developing time is longer than for standard films (about 4 minutes).

Chair-side processing units are available and allow for the rapid processing of films without the need for a dark room. Because smaller amounts of developer and fixer are used, the solutions can be replaced more often without great expense.

There are also automatic processing units specially made for dental films. They work best for dental film compared to standard automatic processors, because the rollers are the appropriate size for the film. However, they are expensive and in my experience tend to malfunction on a consistent basis as they age. They may be more ideal for those practices taking large numbers of dental radiographs.

There are also rapid developer and fixer solutions available (more concentrated than standard) to speed up the processing process. These will aid in shortening the general anaesthesia time for the pet. The developing time can be reduced to 20 seconds (normally 4 minutes) and fixing time down to 2 minutes (normally 10 minutes).

E-speed films require a red filter safe light, whereas D-speed films can utilise an orange or red filter safe light. Chair-side processors tend to have an orange tinted plexiglass window which allows the operator to visualise the handling of the film during the processing procedure.

Reading the film.

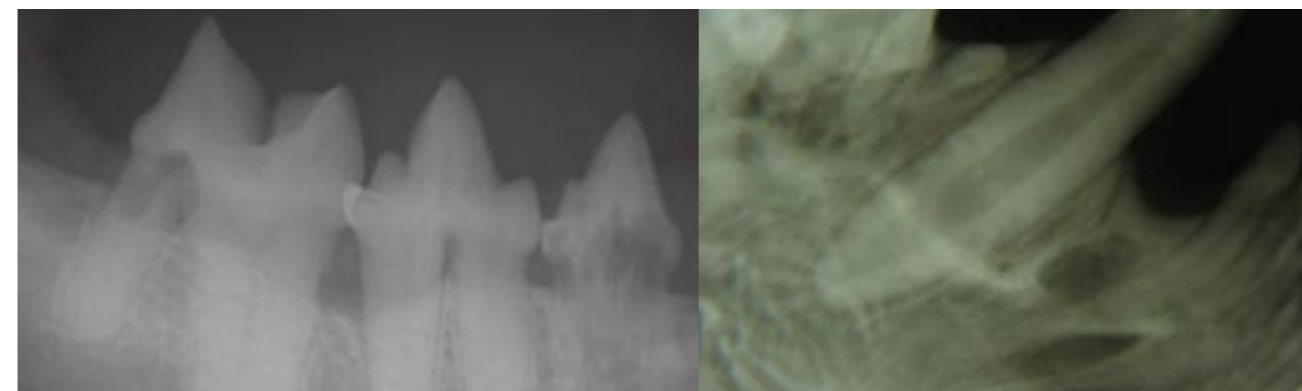
The end result of a processed film is a negative with various degrees of lightness and darkness that is best viewed on a clean viewing box. The blackness of the film is the density and the range of densities, or shades of grey from white to black, is the radiographic contrast. When the contrast between structures is sufficient for the eye to distinguish one shade from another easily, the radiograph is said to have good detail. In human dentistry, the ability to differentiate between shades is important in the early detection of dental caries. The radiographic diagnosis of feline odontoclastic resorptive lesions also requires an ability to differentiate between shades. Magnification also aids in the interpretation of dental radiographs.

Storage of films.

Due to their small size, dental films can be easily lost. Storage of films in envelopes or in dental frame mounts is advisable. Also with the advent of digital photography, dental films are easily converted into digital images for storage on a computer.

Techniques for Oral radiography

The object of dental radiography is to produce a radiographic image that is a dimensionally accurate reproduction of the actual object i.e. there is no foreshortening or elongation of the image.



Left: Parallel technique mandibular teeth in cat with resorptive lesions. Right: Lateral oblique view of max. canine tooth with pulpotomy procedure.

Vertical versus horizontal angulation

Vertical angulation is the degree of angulation above or below the neutral line 0 degrees, a line perpendicular to the long axis of the tooth. Foreshortened images result from excessive vertical angulation and elongated images result from too little angulation. Vertical angulation is intentionally used for the bisecting angle technique.

Horizontal angulation refers to the movement of the tube head in a mesial or distal direction from the centre of the object being radiographed. Horizontal angulation is used so that there is no overlapping of structures and it is used also in the tube shift technique (discussed later).

For intra-oral radiography the two techniques that are used most often are the parallel technique and the bisecting angle technique.

Parallel technique:

The simplest technique is the parallel technique and as the name implies the film and the long axis of the object are parallel to each other and perpendicular to the primary X-ray beam. The technique is used to image the mandibular premolars and molars.

The vertical angulation can be plus or minus up to 20 degrees and still be acceptable for a parallel technique.

Bisecting angle technique:

The bisecting angle technique (BAT) is the most often used in dental radiography because it provides the least distortion and the most easily reproducible positioning technique for periapical studies. It is used to image all the incisors, canines and maxillary premolars and molars.

BAT is implemented by placing the film as close to parallel to the long axis of the tooth as possible. The primary beam is then directed perpendicular to the line that bisects the angle formed by the film and the long axis of the tooth. In doing this, the image is neither foreshortened nor elongated.

Special techniques

The lateral projections of the mandibular and maxillary canines are helpful in assessing the periapical region, and overcome the overlap of the canine tooth with the third incisor and premolar teeth around the canine apex.

Intra-oral views of the temporomandibular joints may be done by placing a size 2 dental film in the oro-pharynx as far dorso-caudally as possible, with the white side of the film packet

facing dorsally and the dot positioned rostrally. The x-ray beam is directed towards the film over the patient's ear.

The tube-shift technique (SLOB rule- same lingual opposite buccal) provides the operator with the ability to differentiate a three dimensional three rooted tooth on a two dimensional radiograph. The technique can be used to separate and identify the roots of a three rooted tooth or show the buccal/lingual position of e.g. an impacted tooth. After taking a standard BAT lateral projection of the maxillary fourth premolar with the consequential superimposition of the mesiobuccal and palatal roots, a second radiograph is taken by moving the tube head rostrally (Primary X-ray beam coming from a more rostral position) by about 30 degrees- this rostrocaudal oblique view allows for the separation of the mesiobuccal and palatal roots of the maxillary fourth premolar. In this second view the palatal root will move in the same direction as the tube head namely in a rostral or mesial direction. Occasionally this positioning will result in superimposing the apex of the distobuccal root over the first molar. This will necessitate an additional 30 degree caudorostral oblique view to isolate the distobuccal root of the maxillary fourth premolar radiographically.

The separation is valuable in defining the pathology associated with advanced periodontal disease, or when diagnosing and treating endodontic disease in this region.

In cats and brachycephalic dogs, the zygomatic arch may be superimposed over the maxillary premolar tooth roots. If the collimator is placed in a rostral oblique position, the zygomatic arch can be shifted off the area of interest. The collimator can also have less vertical angulation. This will cause elongation of the tooth roots and allow the apices of the roots to be seen without the zygomatic arch being superimposed.

Summary

Today, oral radiography and the use of dental X-ray units are considered standard practice for those people wishing to offer a quality veterinary dental service.

Intra-oral radiographs provide a wealth of information, information that usually cannot be found during a visual inspection of the oral cavity. This information will certainly aid in reaching a diagnosis for a particular case as well as possibly altering your management of that case.

Instruments & Equipment

FELINE INSTRUMENTS

iM3 Purr-fect Feline Instruments



Feline 8 Piece Hand Instrument Kit

The feline/small dog periodontal kit has been designed exclusively for use in cats and small dogs. It's design allows the practitioner to perform a complete oral examination (including detection of feline resorptive lesions) and cleaning of all tooth surface – both supra and subgingivally (above and below the gum). All instruments are available individually.

PROVET CODE: D2000 Feline 8pc Hand Instrument Kit.
PRICE EX GST: \$315.59

1mm & 2mm Elevators

1mm and 2mm wide straight tip elevator.

PROVET CODE: DENT D2001 Elevator 1mm
PRICE EX GST: \$49.89

PROVET CODE: DENT D2002 Elevator 2mm
PRICE EX GST: \$49.89



Probe/Explorer

One end has periodontal probe markings 1, 2, 3, 5, 7, 8, 9, 10mm. The fine but robust tip is ideal for periodontal probing in the cat or dog. The markings are indented into the probe and will not fade even after many autoclave cycles (colour coded periodontal probe markings tend to fade with autoclaving). The other end had a shepherd hook explorer to detect tooth defects (including resorptive lesions and pulpal exposures) both supra and subgingivally (above and below the gum).



PROVET CODE: DENT D2003 Probe/Explorer
PRICE EX GST: \$31.99

Periosteal Elevator

Double ended elevator. The small delicate flat ends of this instrument make it ideal for raising gingival flaps in cats. The rounded tip helps prevent accidental slippage and tearing of the gingival flap.



PROVET CODE: DENT D2005 Periosteal Elevator
PRICE EX GST: \$37.11

Resorptive Lesion Probe

This probe can be used to detect resorptive lesions or residual calculus subgingivally. The probe can also be used to identify furcation involvement (loss of alveolar bone between tooth roots).



PROVET CODE: DENT D2006 Resorptive Lesion Probe
PRICE EX GST: \$31.99

Instruments & Equipment

FELINE INSTRUMENTS & MICROSCOPES – CONT'D

Extraction Forceps – small

These comfortably weighted extraction forceps are designed to grasp small teeth. The spring action allows for ease of use without excessive force being supplied to the tooth crown.



PROVET CODE: DENT D2004 Extraction Forceps
PRICE EX GST: \$75.48

Sickle Scaler

This double ended hand instrument is used for the removal of supragingival (above the gum) plaque/calculus and stain.



PROVET CODE: DENT D2007 Sickle Scaler
PRICE EX GST: \$31.99

Curette

This slimline curette is ideal for calculus and plaque removal both supra and subgingivally (above and below the gum). The fineness of the instrument is well suited for use in cats and small dogs.



PROVET CODE: DENT D2008 Curette
PRICE EX GST: \$31.99

Microscopes

Two cost-effective laboratory-styled microscopes.

- Model B3-320S with inclined binocular eye tubes, 30 degrees inclined
- Coaxial coarse and fine focusing controls
- Full mechanical stage with coaxial under slung controls
- Illumination 6v 20w quartz halogen
- Abbe sub-stage condenser, NA 1.25 with markings on the iris diaphragm for each objective
- Achromat objectives 4x, 10x, 40x, 100x (oil); paired wide field eyepieces 10x
- Model B3-320TR with trinocular head (for image capture) and 'C' mount video adaptor (camera not included)

PROVET CODE: MICR B3 2
PRICE EXL GST: \$1,385

PROVET CODE: MICR B3 1
PRICE EXL GST: \$1,240



Model B3-320S

Model B3-320TR

Instruments & Equipment

DENTAL UNIT

iM3 GS Deluxe Veterinary Dental Unit

Advanced engineering at an affordable price.

- The iM3 GS Deluxe is designed as a high quality veterinary dental work centre.
- It allows the Veterinarian to perform everything from extractions and sectioning teeth using the High Speed Handpiece to polishing using the Low Speed Handpiece with iM3 R&R prophyl heads. It has been upgraded with features only available in the iM3 Pro 2000 range. These include the CLS Flush System. Simply press the auto flush button on the control panel and CLS is immediately diverted into the airline of the high speed handpiece, flushing out the airline and High Speed turbine; all in a matter of seconds, it helps minimize cross contamination and preserves the turbine, which saves you valuable time and money (another industry first).
- The GS Deluxe also features a 2 bottle water system, which allows the user to switch between water and CLS at the touch of a toggle.



Instruments & Equipment

DENTAL UNIT – CONT'D

Here's what Dr. Jeanie Hawkins, DVM, Diplomate AVDC had to say about the Auto Flush System and CLS Enviro Solution...

“Having CLS Solution at my fingertips to flush periodontal pockets is a real plus. iM3® is the only Company to address the problem of cleaning the airlines and high speed handpieces or scalers by using a moment button to release CLS Solution into the airline.”

- The control box is manufactured from super thick aluminium and finished in hospital grade powder coat.
- Our handpiece lines are straight, much easier to clean than coiled hoses.
- The work surface is Corian®, with a groove around the edge to prevent burs falling on the floor. Corian® is a non-porous, virus impervious surface that is easily cleaned and stain resistant (even dried blood wipes off).
- Each unit has the maintenance instructions on an attached card, when the book and the person responsible for maintenance is no longer around, the card will be.
- Every unit is fitted with its own water system and filter to prevent blockages (using distilled water). All the supply lines are colour coded so we can diagnose service requirements in seconds.
- The iM3 GS Deluxe is built to last. The unique air and water supply valves used on the iM3 GS Deluxe (in fact on all iM3 dental units) will keep on working well beyond the life of an ordinary valve.
- The GS Deluxe has a height adjustable Stainless Steel instrument tray for extra storage.
- The toggle valves on all iM3 units use a unique Cartridge system, allowing the owner to replace the valves quickly with no down time should it become necessary.

- An Ultrasonic scaler coolant outlet is fitted to the rear of the unit to allow pressurized water or CLS (chlorhexidine, glycerine and alcohol solution) to be supplied to your ultrasonic tooth scaler (no more pump up tanks!).
- A clear water bottle provides water for your dental system and brown bottle contains CLS (CLS is light sensitive). The GS Deluxe requires some form of compressed air. iM3 manufactures the Silent Hurricane Compressor which fits neatly under the dental unit. Alternately an aftermarket compressor can be sourced from the local Hardware Store. Veterinarians who take their unit with them to other practices can also use bottled Nitrogen gas.
- iM3 Designs, Manufactures, Sells and Services all of its units – your guarantee of quality and long life.

PROVET CODES:

- DENT U3011
GS Deluxe, PB High-speed drill, 2pc low speed for polishing, S/S stand, 2 bottle coolant system, instrument tray, flush system, power strip.
- DENT U3012
GS Deluxe, PB High-speed drill, 2pc low speed for polishing, silent compressor, 2 bottle coolant system, instrument tray, flush system, power strip.
- DENT U3018
GS Deluxe, PB High-speed Fibre optic drill, 2pc low speed for polishing, S/S stand.
- DENT U3019
GS Deluxe, PB High-speed Fibre optic drill, 2pc low speed for polishing, silent compressor.