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Dentistry for Nurses April 2014 Mini Series

Session Three: Advancing the Service an Improving Care

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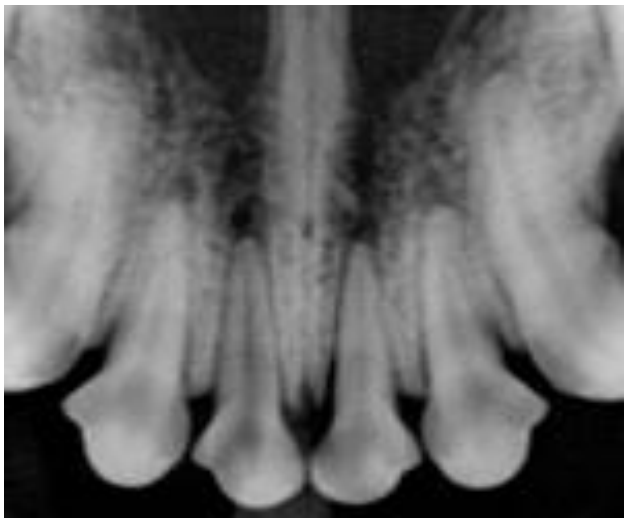
Veterinary Dental, Oral & Maxillofacial Referrals



DENTAL RADIOLOGY
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Intra-oral radiography is an essential and standard technique for imaging the oral cavity. It is widely used for dentistry, oral surgery and maxillofacial surgery including trauma and oncology cases. The information provided is critical for a full diagnostic examination and resultant treatment plan; as with other veterinary disciplines, accurate treatment is difficult to impossible prior to achieving a diagnosis.

EQUIPMENT:

X-RAY MACHINE: Intra-oral imaging can be performed with either dental or standard Xray machines. Dental Xray machines are preferred as their use is far more efficient; rather than moving the animal, the head of the Xray machine can be rotated and tilted to provide correct alignment of the beam. To achieve this with a standard Xray machine, accurate positioning of the animal's head, with foam wedges or tissue, is required. This slows the process and purchase of a dental X-ray machine, which would pay for itself in a very short period, is recommended. Only time alteration is necessary with dental X-ray machines, while standard X-ray machines are not recommended, some equivalence is achieved with approximately 50cm focal distance and 60-70kV, 10-20mAs.


Dental xray machine

FILMS: Intra-oral, non-screen film is necessary to obtain high quality, diagnostic images of oral anatomy. Views of the whole head are of little value as the degree of superimposition is high. This is true for both standard screen film and smaller, non-screen film in plastic envelopes. Non-screen dental films give superior results owing to:

i) Non-screen film providing a high resolution image

ii) Tiny film sizes allow intra-oral placement reducing superimposition

Sizes available: paediatric (0, 1), periapical (2) and occlusal (4). Sizes 2 and 4 are of greatest use in the veterinary situation; however sizes 0 or 1 are useful in cats and exotics.

Dental films

The plain white side with convex corner marker or 'nipple' faces the x-ray tube. A labelled opposite side provides a tab for opening the film. Internally several layers are apparent: lead leaf, paper envelope and film itself centrally. The 'nipple' is present on all layers of the film and enables a standard positioning protocol (nipple points towards the X-ray tube and the front of the mouth) and subsequent orientation of images, in lieu of left/right marking.

PROCESSING: Wet, dry or digital methods can be used.

a) WET- rapid developing and fixing fluid designed for use with dental films is most appropriate. A row of four plastic cups containing in sequence: developer, water, fixer, water is utilised, either in an existing darkroom or by use of a chair-side darkroom/developer. The latter is a small light-proof box; effectively a miniature darkroom. Clips are required to hold each film and a clip 'tree' should be purchased to hang fixed films while drying.

The operator can process and view the image within 2 minutes.
Alternatively self developing and fixing films can be obtained. These require no additional purchase of equipment as the chemicals are self-contained. If you have dry or digital developing, the additional ability to utilise the wet method, in case of emergency, is very useful.


Chair-side dark room

b) AUTOMATIC- some machines can take dental films as well as standard films- check first! A small, dental processor is available giving a dry image in 4minutes.

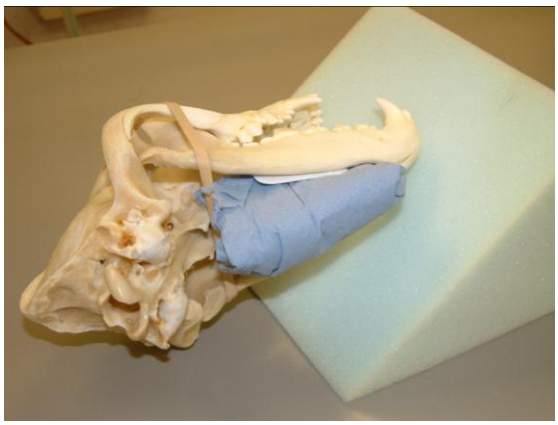
c) DIGITAL-direct and indirect methods, images may be modified or highlighted. Indirect uses small 'films', while direct radiography images are transferred to computer, via a film-shaped probe, within seconds. Probe sizes available are limited however.

RADIOGRAPHIC TECHNIQUE:
Two imaging techniques are utilised in the oral cavity, parallel and bisecting angle. The latter is required as, owing to the anatomy of the oral cavity, it is not possible to obtain diagnostic views of all dentition while implementing only the simple, parallel approach. The bisecting angle technique enables imagery of anatomy, of accurate proportion, despite the inability to position a film directly behind the object.

A diagnostic view of dentition requires that all roots and the 3-5mm bone 'apical' to root tips ('apices') be present. This enables assessment of 'periapical pathology', eg abscess. With smaller film sizes, capture of this area of anatomy and the crown is impossible. A larger film size should be selected or the apical areas prioritised; a second film could be used to view coronal anatomy (towards the crown).

PARALLEL
The technique employed when imaging body cavities or limbs; the object is positioned parallel to the film and X-ray beam directed perpendicular to both. If performed correctly there is minimal image distortion.

This is limited intra-orally, namely to views of the mandibles or maxilla for trauma or oncological purposes, and for the mandibular premolars and molars. In some animals, position of the mandibular symphysis dictates that mesial (anterior) premolars cannot be imaged in this manner and bisecting angle technique is required.


Parallel technique, mandibular dentition-note wedge to avoid rostral tipping.

Films are positioned for maximal diagnostic information, ie minimal extension beyond the oral cavity. For mandibular premolars and molars this requires vertical film placement between the tongue and mandible, until the film edge is level with the ventral mandibular border. In this way sufficient periapical bone imaging is ensured.

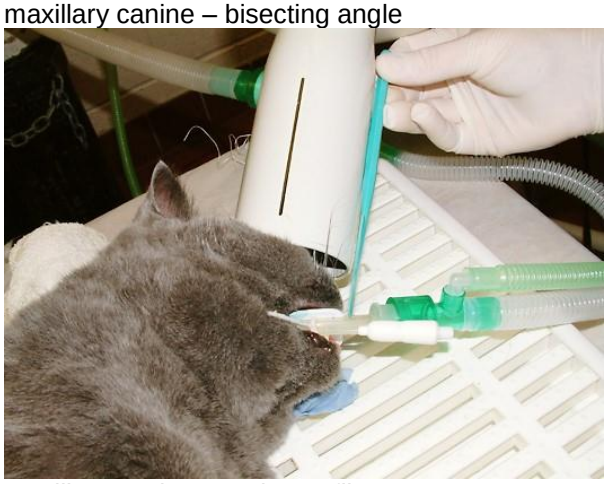
BISECTING ANGLE
The bisecting angle technique allows the operator to image areas of oral cavity and dentition with minimal superimposition and maximal accuracy where parallel technique is impossible due to adjacent structures. If one attempts parallel imaging of maxillary dentition it becomes obvious that only the crown and a tiny portion of root will fit onto the film; the palate prevents the film placement required. The bisecting technique eliminates the need for the film to be placed directly behind the structure in question.

The bisecting angle line is found by dividing the angle made between object and film into two equal halves. If the X-ray beam is then angled to hit this line in a perpendicular fashion, the resultant image matches object size. Since teeth tend to curve a 'best fit' line is used from crown to root to create the object angle. This will produce some areas of distortion but is usually diagnostic; where specific portion detail is required (eg root) that area would form the object angle.

Assessing bisecting angles:

lower incisors

maxillary canine – bisecting angle



maxillary canine –coning to film

Where a dental Xray machine is used the manoeuvrability of the head enables easy beam angling, in the case of a standard Xray machine the animal's head must be carefully positioned to ensure success.

Multiple views are required to assess structures more fully; a view in only one plane of a 3D object may be misleading. This is especially true with multiple rooted dentition and where cross section is ovoid rather than cylindrical (eg canines).Here the bisecting angle and thus angle of beam remain, but left to right aspect alters. This principle is also utilised to avoid superimposition of adjacent teeth; slightly altering the aspect 'throws' the image into a clear space, eg maxillary canine: towards palate and away from premolars in its arcade.

PROCESSING

WET- Open the film envelope in a darkroom and discard all layers to access the film. Handle only the film edges or by placing a clip on an outer edge (nipple position) to minimise artefacts such as fingerprints. Place into the chemicals as below:

1. Developer- until an image is apparent; 30-45seconds (reduced with fresh chemicals).

2. Water- short rinse/ agitation. Some authors additionally utilise this step prior to placement in developer.

3. Fixer- 2 minutes are required before viewing the image, however a brownish discolouration indicates that further time is necessary, especially as chemicals become exhausted. Fix for approximately 10 minutes after initial view.

4. Water-short rinse before viewing. After final fixing, rinse films thoroughly, removing all 'soapy' feel from the film.

5. Dry fully, place in labelled envelopes or specifically designed plastic mounts.

Failure to thoroughly fix then rinse the films will result in images which deteriorate when archived.

Self developing and fixing film: film held downwards, chemicals uppermost whilst squeezed through the connecting 'stalk' and into the film area. The film plus chemicals are agitated for 1minute then opened and rinsed under running water. While this gives convenience, the author prefers standard processing image quality.

RADIOGRAPHIC TECHNIQUE FAULTS

INACCURATE FILM POSITIONING:
The most frequent error is allowing insufficient film area for the dentition in question, leading to areas of missed anatomy, often the periapical area. It is vital to have all the information present to enable diagnostic interpretation. The periapical area is most important and should include 3-5mm of surrounding bone. This is achieved by careful placement of appropriately sized film.

INCORRECT BISECTING ANGLE TECHNIQUE:

A) INCORRECT VERTICAL ANGULATION

Elongated, thin image - Xray beam angle too shallow onto film
- false positive periapical lucencies, pulp falsely narrow

Short, fat image - Xray beam too steep onto film
- periapical pathology hidden, pulp appears wide

B) INCORRECT HORIZONTAL ANGULATION
Superimposition – failure to align the beam in such a way that the image is 'thrown away' from adjacent anatomy (eg neighbouring dentition).

FILM FLEXION:
Distortion should be avoided by keeping films flat, through use of paper or sponge when positioning.

INCORRECT XRAY MACHINE SETTING:

Pale, indistinct image- underexposure

Dark, indistinct image- overexposure

PROCESSING FAULTS:

Pale, indistinct image- underdeveloped /exposed to light.

Dark, indistinct image- overdeveloped.

Brown image – insufficient fixing.

Dark marks – error during developing; use clean filmclips attached away from the image/ handle edges only.

Pale marks – fixer fault (rinse film clips in water between films)/ under developed/ chemicals contaminated.

Scratches – during handling/ rinsing; care with fingernails!

Films should be mounted and assessed on a film viewing box with sufficient coning of light. Magnification is advised.

NORMAL RADIOGRAPHIC ANATOMY

ENAMEL- the densest tissue in the body, it is seen as white opacity over the crown, most obviously when edge-on.

DENTINE- this forms the bulk of the tooth, within both crown and root. It is a hard, porous material with density greater than bone but inferior to enamel. Dentine is produced by the pulp as the animal ages, thereby thickening the walls. This fact can be used to estimate both age and pulp viability of a tooth.

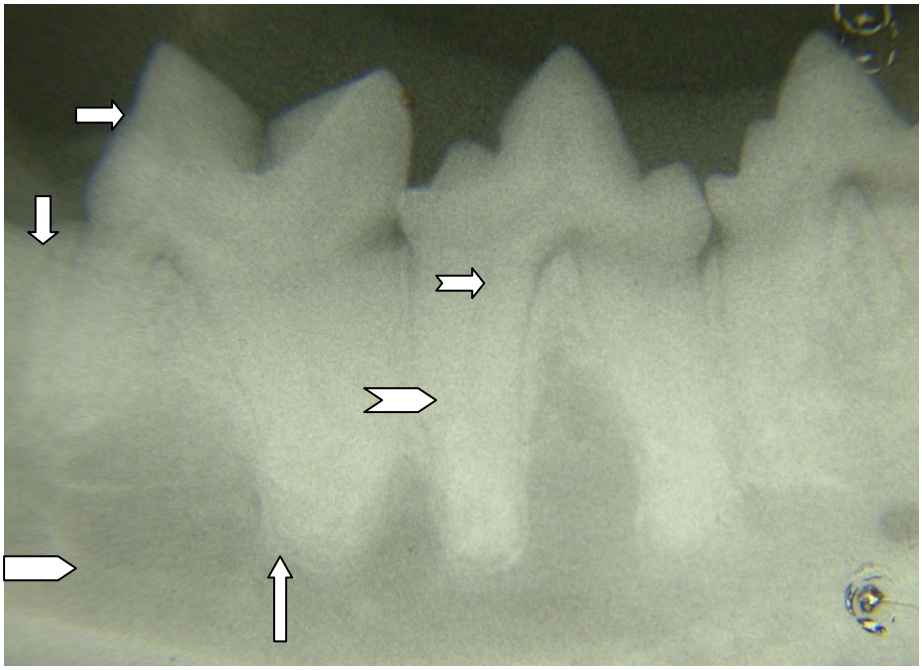
PULP-the living centre of each tooth, containing blood vessels, nervous, lymph and connective tissues. In laying down the thickening dentinal walls, the pulp becomes thinner as the animal ages.

CEMENTUM- coats the outside of the root but is generally too thin to be identified.

PERIODONTAL LIGAMENT- provides support between root and socket by fibrous attachment from cementum to alveolar bone. Its density results in a thin, radiolucent line describing the extremity of the roots and the socket shape. Radiolucent apical widening represents the area in which the neurovascular supply enters each root via the ‘apical delta’.

ALVEOLAR BONE- bone forming the tooth socket; extremities are delineated as:

Alveolar crest: most coronal height, normally matching the root height.
Lamina dura: white line describing the socket edges. Normally this shape closely matches root anatomy.



Radiographic dental anatomy: enamel of crown (top arrow), alveolar bone (downward arrow), pulp cavity (notched arrow), dentine (chevron), mandibular canal (block arrow), lamina dura and periodontal ligament space (upward arrow)

NUTRIENT CANALS-running through bone of the maxilla and mandibles these house and protect neurovascular bundles supplying the adjacent dentition and soft tissues. The soft tissue contained results in linear, radiolucent, radiographic signs.

Maxilla: infraorbital canal

Mandible: mandibular canal

FORAMINA- seen as radiolucent circles, these enable entry and exit of neurovascular bundles to nutrient canals. Their position may be close to adjacent dentition and care must be taken to avoid interpreting their presence as pathology.

Maxilla: infraorbital foramina lie above the mesial roots of the fourth premolars (‘carnassials’)

Mandible: mental foramina should be noted, positioned directly ventral to the mesial root of the second premolar and therefore adjacent to the apex of the canines.

SUMMARY:

Equipment required to instigate intra-oral radiography represents a small investment in order to achieve greatly enhanced diagnostic capability. Once mastered, the techniques can be utilised in daily surgery with little increase in operative time. Practical tuition is recommended to aid the process.

Intra oral radiography is essential in the investigation of dental, oral and maxillofacial trauma and disease. It eliminates guesswork, preventing many potential surgical complications. Intraoral radiology should be regarded as a vital, daily tool for the formulation of an accurate diagnosis and appropriate treatment plan.

ADVANCING THE SERVICE

The role of the Veterinary Nurse in successful management of dentistry patients is vital. Careful assessment of pets and their owners is required to identify pathology and select suitable treatment options for the animal's long term benefit and client's satisfaction. The majority of treatment requires general anaesthesia; patient type and the nature of treatment calls for specific considerations and techniques to optimise results.
Finely balancing the support of patients, clients and surgeon alike can prove challenging. Confidently approaching and managing both patients and theatre is crucial to success.

Anaesthetic aspects and hidden danger

Full oral assessment requires general anaesthesia:

1) Operator safety – sedated animals may still bite (you & films/ sensors!)

2) Patient safety – protection of the airways; especially with liquid usage

3) Examination quality – enables more thorough examination

4) Treatment – treatment required, including surgery, may be performed

1) Operator safety: Appropriate choice of premedicant drugs based on the patient type, weight, temperament, health parameters and treatment anticipated. Suitable anaesthesia regime and positioning- ergonomic considerations to prevent trauma when lifting or, more chronically, while operating. The back should be straight, shoulders back and table-top no higher than (seated) elbow level. Good lighting, focal point type, and or loop ocular magnification helps maintain correct posture. Saddle-seats help and a variable height, tilting operating table is far superior to a fixed tub-table. The latter may prevent normal knee position.

Equipment required for the procedure should be placed within easy reach of the operator without the need for rotation of the operator's body. This includes gloves, goggles and face mask - beware debris & aerosol!

Ensure sufficient depth of anaesthesia prior to intubation and, where ever the operator is required to place hands within the mouth. This is particularly vital where stimulation occurs eg occlusion check involving both temporary extubation and tucking of the tongue back into the oropharynx. An atraumatic gag should be used.

2) Patient safety: Pre-operative tests should be elected as appropriate based on history and clinical signs. This will include non-oral aspects which may affect treatment or anaesthetic protocol eg renal status as well as specific tests for oral disease. It should be noted however that oral and dental status can have a bearing on systemic health eg via the effects of bacteraemia. The oral cavity can affect and act as an indicator for disease eg diabetes (two-way deleterious influence with periodontal diseases), renal compromise (oral mucosal ulceration). Oral disease is disease! Where unusual or advanced disease pattern is noted testing is advised. Testing considered: Biochemistry; Electrolytes; Haematology; Urinalysis (dipstick & refractometer SG); Viral testing – blood eg FeLV, FIV & oral swab eg FCV, FHV

Appropriate choice of premedicant drugs and anaesthesia regime based on the patient type, weight, temperament, health parameters and treatment anticipated. Induction drugs are given slowly to enable full appreciation of effect without inadvertent overdose. These factors may be of especial importance given the high proportion of geriatric patients requiring dentistry. Equally, some malocclusion cases will present as paediatric patients. The ability to cope with general anaesthetic is much increased after 8weeks of age due to their reserve capacity. The use of fluids creates problems with airway protection and body temperature.

Airway protection – cuffed ET tubes, ideally silicone with 2 murphy eyes and, since cuff inflation will be required, a low-pressure, high-volume cuff. Silicone resists kinking (by bending instead) and gas-flow obstruction more than other materials- the worst offender being

the red-rubber type. Armoured tubes, with in-built wire coil, is even better however it can be crushed with large forces and is harder to shorten in small patients. Two Murphy eyes help maintain gas-flow if even if one is occluded eg by mucus, however rattling should always be attended to and tube cleared. Red-rubber tubes have high-pressure, low-volume cuffs which may be more detrimental to the trachea. Inflation of any cuff should be done slowly and carefully, checking the tension of outer 'bubble' is sufficient but depressible and thus not excessive. For small patients a 1ml syringe is appropriate. Note the air volume used on a chart and ensure its' removal before extubation.

The patient may be positioned in recumbency as required however the head should be positioned slightly lower than the rest of the body. This may be achieved by tilting an operating table and or placing an appropriately sized rolled towel beneath the neck. Note that a grilled tray to catch fluids may elevate the head and need to be compensated for. The animal's body may be slightly elevated by underlying heat pad and towel/bedding. Avoid kinks in the animal's body which could lead to post-operative discomfort.

Once intubated, ensure that any movements of the patient do not cause accidental movement of the tube as this may lead to tracheal damage. To rotate a patient, ensure that they are disconnected from the breathing system and that the head is always kept lower than the rest of the body, usually rolling the legs ventrally.
Throat packs eg sponge type will prevent solid debris eg parts of tooth or calculus from entering the trachea but do not offer protection against fluid. Once soaked, the pack will continue to let fluid through. They should be squeezed out and cleaned of debris, blood clots etc regularly if used. To ensure they are removed at extubation the tie should be affixed to the ET tube connector.

Body temperature preservation - in addition to the head-down positioning and grilled tray (or tub table type set-up depending on clinic) an absorbent pad or plasticized 'bonnet' may be placed around the animal's head to prevent soaking and thus cooling. Heat pads should be chosen to avoid danger from electricity and water mixing! A bear hugger gives good warmth but remember that any heat source has the capacity to cause burns- check both rectal temperatures and contact-points. Bubble wrap and foil helps retain body heat but will restrict warmth from a heat pad if placed between heat source and the patient. They are superior to blankets as their weight is minimally restrictive to breathing chest movements. Soft bedding between the heat source and patient provides more even spread of warmth by reducing pressure spots. Carefully and frequently monitor temperature, especially in small patients.

3) Examination quality: Enables more thorough examination. See 'oral assessment'.

4) Treatment: An appropriate treatment plan is based on the diagnostic evidence gleaned during assessment. Lack of through investigative procedure often leads to complications for both the patient and vet and clearly also does the client a disservice. Both the presenting problem and final treatment plan should indicate the anticipated degree of pain and thus analgesia required. It is essential for the animal's welfare that we do not underestimate potential for oral/ dental pain and the affect that this can have on our patient.

Pre-emptive analgesia: the value of this is well documented for any procedure where noxious stimulus is involved. The aim is to prevent the phenomenon of 'wind-up' and a self-perpetuating cascade of inflammatory mediators from noxious stimulus.

Pre-emptive blocking of pain perception: reduces inhalant anaesthetic required to maintain stability during surgery, interventional analgesic drug use, healing time, hospitalisation/ recovery time. This is of benefit to patient, client, staff and efficiency alike. If central sensitisation or wind-up has already occurred it becomes difficult to arrest this process and return the animal to a pain-free state. Local analgesia is the most effective form of analgesia, as nerve blocks and / or infiltration – a combination of techniques (as a human dentist would use) is usually needed for adequate analgesia. Nerve blocks are best placed near, rather than inside, foramina in order to reduce risk of nerve damage or intra-vascular injection.
The safe maximum dosage should be calculated and amount injected kept well below this amount to avoid toxic effects.

Multimodal analgesia: A balanced, compatible, combination of analgesic drug used pre, intra and post-operatively, gives most complete analgesia by blocking nociceptive pathways at various levels. Multi-modal analgesia may include analgesics such as opiates and NSAIDs given within the pre-medicant regime, coupled with nerve blocks and post-operative analgesics for the anticipated period of discomfort. Local anaesthesia is particularly effective pre-operatively as it locally blocks transmission of the noxious stimulus.

Halstead's Principles: Surgery should be as atraumatic as possible; uncontrolled tissue trauma such as bone crushing and gingival maceration is associated with increased pain and healing delay. It is preferable to utilise a surgical ('open') extraction technique with controlled bone removal via a mucogingival flap where simple ('closed') technique may cause inadvertent tissue damage. To aid technique, the correct equipment in tandem with care such as instrument sharpening, is vital. Sharpening should be performed on a weekly basis.

Advanced Treatments

It is essential that advanced treatments are performed only by suitably trained, experienced and qualified individuals with the correct equipment. These treatments should not be attempted where a dental xray machine, and skilled operator who can reliably produce perfect intra-oral, dental xray images, is not present.

Awareness of the availability of these treatment options is important to ensure clients can make fully informed consent to any treatment type. Increasingly clients check on the internet and with other pet owners; having sound general knowledge of the subject is useful to you as a veterinary professional and helps instil confidence in your clients.

1. **Maxillofacial surgery** – trauma and oncology, also some malformations.
   Examples - jaw fracture, tumour excision, cleft palate, oronasal fistula

   - A sterile theatre approach is used, surgical kits, drapes, swabs, suction.
   - Special surgical equipment includes osteotomes and mallet, periosteal elevators and sterile bone-cutting unit (sterile, low-speed hand-piece with HP burs).
   - All cases should receive adequate local analgesia in addition to standard regime.

2. **Restorations** – fillings, altered tooth shape and sealing, desensitisation. For fractured teeth, caries, discoloured teeth, tooth wear, dysplasia.

   High-speed hand-pieces are used with FG burs to cut tooth.

   Materials to restore teeth are usually composite. These materials are 'glued' to the tooth using a bonding agent (resin). To do this the following is required:

   - Acid etch (from syringe or with micro-brush from pad/glass block)
   - Bonding agent (in dappens dish, with micro-brush)
   - Composite (from syringe onto block or from compule using a 'gun')
   - Instruments – flat plastic, smooth-ended plugger or burnisher
   - Light gun

3. **Oral medicine** - investigation and treatment of stomatitis, oro-facial pain

4. **Orthodontics** – treatment for malocclusion, retained or abnormal teeth
   Examples – tooth shape alteration, tooth movement, interceptive treatment/ extractions

May require:

- Different sizes of classic Kong toy (red or black) and /or solid rubber balls.
- Etch and bond materials
- Gun + cartridge of composite-acrylic temporary crown material (e.g. Luxatemp, Protemp etc) + wire reinforcement.

5. **Oral surgery** – e.g. involved extractions, root remnant retrieval, cyst enucleation.
    - A sterile theatre approach is used, surgical kits, drapes, swabs, suction.
    - Special surgical equipment includes periosteal elevators and sterile bone-cutting unit (sterile, low-speed hand-piece with HP burs).
    - All cases should receive adequate local analgesia in addition to standard regime.
6. **Periodontal therapy** – management, tooth salvage, surgery.
   Curettes and subgingival ultrasonic tips are likely to be used.
7. **Endodontics** – e.g. root canal therapy, pulp capping
   Items required include:
    - restorations kit
    - Root canal kit – Round FG burs to access crown (+ any other access burs e.g. Endo-Z, swan-neck burs, Gates-Glydden).
    - Access and widen root canal Gates-Glydden, ‘orifice wideners’.
    - K files (+/- H files)
    - Barbed broaches (to remove pulp)
    - Irrigant solution – hypochlorite or chlorhexidine solution (all approx 2%) + EDTA/citric acid
    - Irrigation needles (safe/ slot-ended)
    - Paper points (dry canal)
    - Gutta percha (‘GP’;fill canal)
    - Sealant (with GP) – often mixed on a glass slab
    - Compaction hand equipment e.g. pluggers
    - Heat source e.g. lighter
    - College pliers/ forceps & mini cotton balls
    - Hand equipment – curette to sear off excess GP, plugger to further compact GP.
    - Glass ionomer, restorative first layer
    - Acid etch, brushes, bonding agent, light gun, glass slab
    - Smoothing equipment e.g. flex-discs & polishing burs
    - Intra-oral (dental) xray films