

Dental Investigation & Xray Mini Series

Session 1: Oral and Dental Assessment– case approach & investigation

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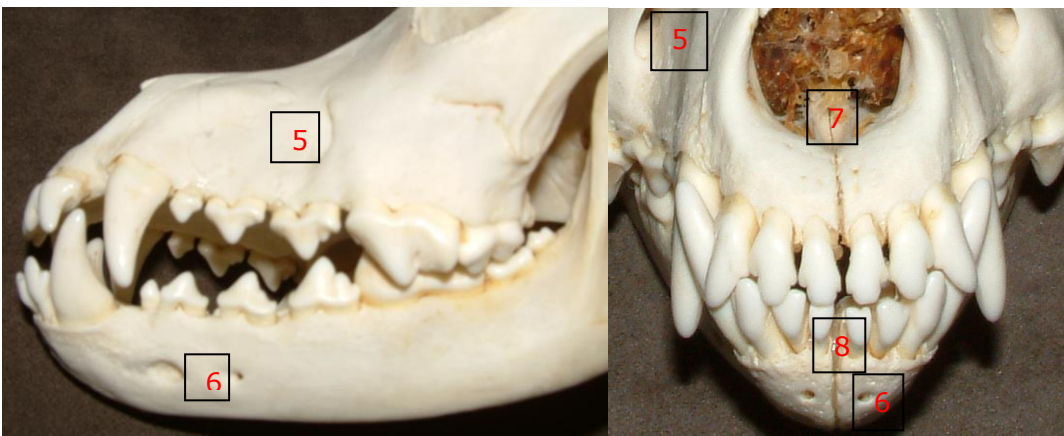
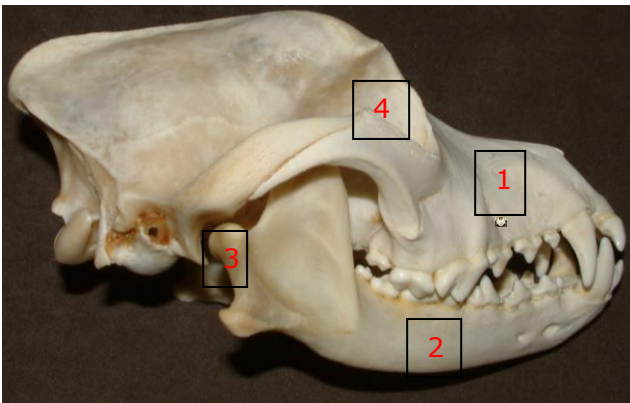


DENTAL ANATOMY & ORAL EXAMINATION

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Relevant Anatomy of the Head

1. Maxilla- upper jaw
2. Mandible - lower jaw
3. Temporomandibular joint (TMJ)- allows jaw movement by articulating the maxilla & mandible
4. Orbit – houses the eye ('globe').
5. Infra-orbital foramen – the hole through which infra-orbital neurovascular bundle exits.
6. Mental foraminae - holes through which the mental branches of the mandibular neurovascular bundle exits.
7. Nasal cavity
8. Symphysis – cartilagenous joint between the two mandible halves



It is vital to be aware of this essential anatomy as disease processes or iatrogenic damage may affect these areas.

Different head shapes:

- Brachycephalic – shortened face
- Mesocephalic – normal facial proportion (ie similar to wild dog)
- Dolicocephalic – elongated face

The head and jaw shapes of different species evolved to best suit their function, much based on diet. Individual breeds, (of dogs especially), exhibit facial shapes selected by man for function and fashion, thus affecting the relationship of mandibles, maxilla and dentition therein, ie the occlusion.

Tooth Development

Embryological stages:

INITIATION – induction - oral epithelium

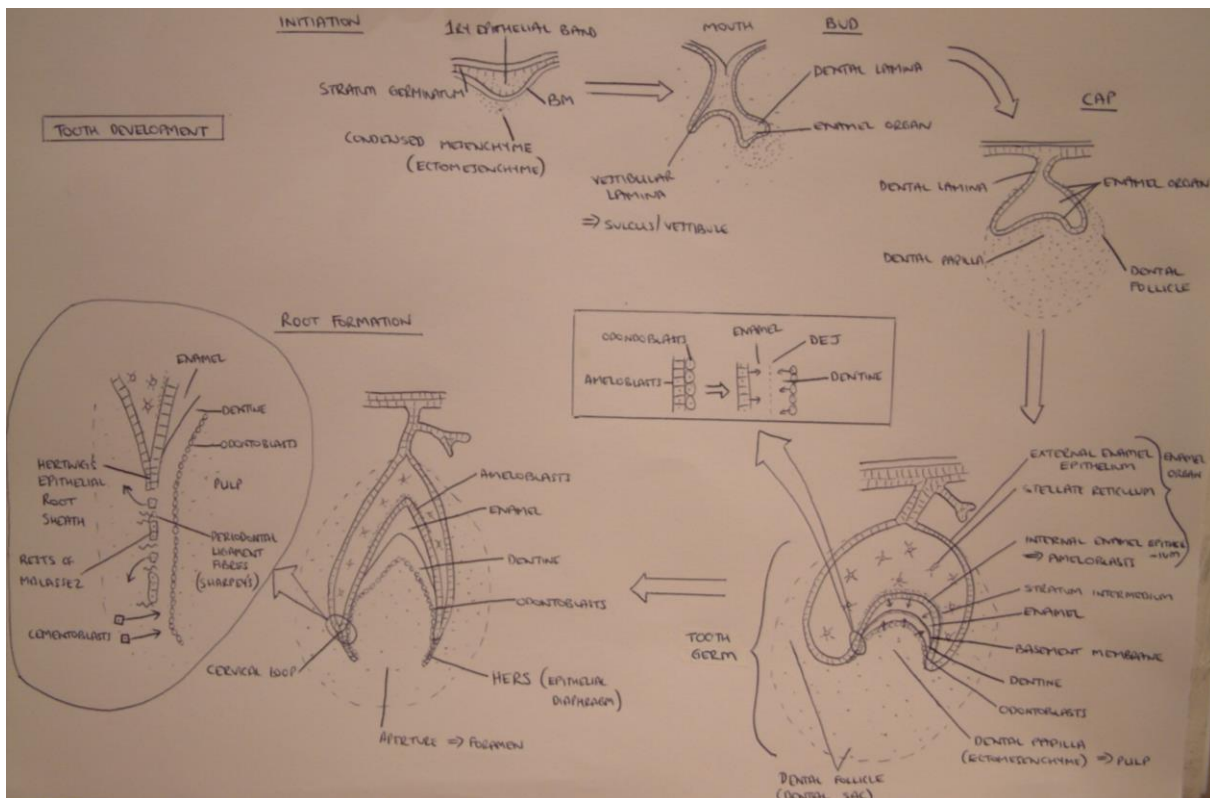
BUD – proliferation - dental lamina & enamel organ formation

CAP – differentiation – tooth germ (enamel organ, dental papilla & dental follicle) formation

BELL – differentiation, proliferation, morphogenesis - enamel organ, dental papilla & dental follicle

APPOSITION – induction & proliferation – root & crown

MATURATION – maturation – root mineralisation & eruption



Tooth development overview © Alex J Smithson Orosurgeon Ltd

Tooth Anatomy

Each tooth consists of a crown and root.

Crown: The visible part of each healthy tooth is known as the crown.

The shape allows specific function. Its 'shape ('enamel bulge') in the cervical ('neck') region of the tooth deflects chewed material from the gum margin, preventing damage.

Root: The tooth roots are hidden by bone and soft tissue. Provides mechanical support for each tooth. May be single, double or triple rooted; multiple roots are divergent to assist mechanical attachment.

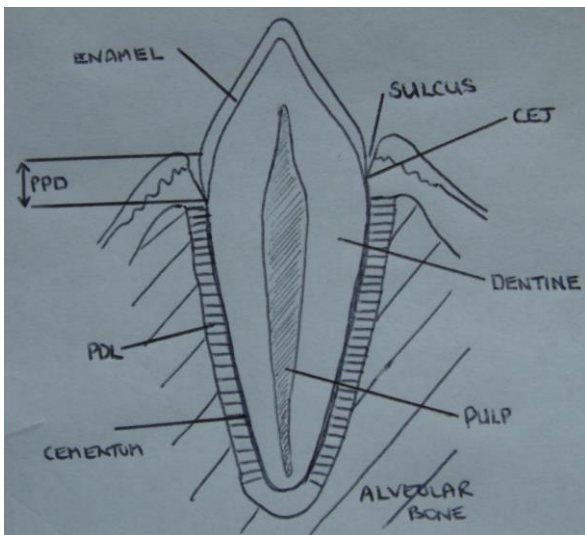
They form the majority of each tooth, approx 60-70%.

Dental Tissues

ENAMEL: densest substance in the body - very hard, glassy, smooth, thin, coats the crown.

DENTINE: hard but 'porous' due to tubules radiating out from the pulp towards the outer surface of the dentine. Produced by the pulp and forms the bulk of the tooth. Increases in thickness with age.

PULP: the living centre of each tooth; includes nerves, vascular system, lymphatics, connective tissue etc. Senses changes (eg heat) as pain. Produces dentine thus narrows with age.



Periodontal Anatomy

GINGIVA – gum. Keratinised, protective collar for tooth.

ALVEOLAR BONE – bone of the socket/ 'alveolus'

PERIODONTAL LIGAMENT – 'PDL': fibrous, sensitive (pain and pressure) attachment between socket and root

CEMENTUM – thin outer covering of roots; allows root-to-periodontal ligament attachment

Oral Soft Tissues

Oral Mucosa

- Oral mucosa is the epithelial lining of the mouth.
- Gingiva is specialised, toughened mucosa.
- Thin, sensitive oral mucosa lines the cheeks and palate beyond the gingival cuff.
- The meeting point of thin mucosa and gingiva is seen as a the 'MUCOGINGIVAL LINE'

Gingiva

- Free gingiva – (gum margin) unattached, out-most rim of gingiva
- Junctional epithelium – gingiva-to-tooth attachment
- Sulcus – tiny gap around each tooth, between free gingiva and tooth. Its base is the attachment point of junctional epithelium to tooth
- Attached gingiva – thick collar of tough, keratinised gingiva attached to bone by fibres

Neurovascular bundles

- consists of blood vessels and nerves.
- run within bony canals in the head
- infra-orbital bundle runs through its canal in the maxilla and exits at the infra-orbital foramen
- inferior alveolar/ mandibular bundle runs through its canal in the mandible and exits at the mental foraminae (caudal, middle, rostral; the middle mental foramen is the largest and located over the apex of the lower canine).

Descriptive Nomenclature & Dental Formulae

Oral Nomenclature

The head may be divided into 4 quadrants:

- Maxillary (left & right)
- Mandibular (left & right)

Areas are further described using the titles below:

- Labial – adjacent to lips
- Buccal – adjacent to cheek
- Palatal – adjacent to palate
- Lingual – adjacent to tongue

- Occlusal – adjacent to the surface of teeth which meets those of the opposite jaw (ie usually the uppermost surface)
 - Coronal – towards the crown
 - Apical – towards the root tip (apex)
-
- Mesial – area of a tooth close to rostral midline
 - Distal – area of a tooth distant to rostral midline
-
- Posterior (human) – caudal (area of mouth)
 - Anterior (human) – rostral (area of mouth)

Combining the above descriptive terms with the tooth identification system (Triadan system, below) enables oral areas, individual teeth and specific sites on teeth to be described.

Tooth types

Teeth vary in shape with different species and the function they perform. The teeth of carnivores have a short crown and larger, true root; these are termed 'brachydont'.

- INCISORS: grooming and nibbling
- CANINES: prehension - catching and holding prey ('fangs')
- PREMOLARS: holding and cutting food into segments
- MOLARS: grinding food; however the first mandibular molars in carnivores ('lower carnassials', LM1) also have a cutting function

The cat is a true carnivore. It has evolved to have only those teeth essential to groom, catch prey and cut food. It has fewer premolars than the dog and only one (first) molar in each quadrant – the lower carnassials and a small, flat-surfaced molar in each side of the maxilla.

Teeth also differ with maturity. Like us, cats and dogs have deciduous ('primary' / 'baby' / 'milk') teeth which are shed and replaced by permanent ('secondary' / 'adult') teeth as the animal matures.

Tooth Nomenclature & Formulae

Tooth types may be abbreviated:

Incisors= I

Canines= C

Premolars= P

Molars= M

Figures then denote the total number of teeth, of that type, per side.

Teeth in the maxilla are numbered first, while mandibular teeth follow an oblique.

Eg C1/1 = one upper and lower canine normally present on each side of the mouth. There are thus 4 canines in the mouth in total.

The dental formulae for carnivores:

DOG= 2x (I3/3: C1/1: P4/4: M2/3)

This creates a total of 42 teeth in the normal dog.

CAT: 2x (I3/3: C1/1: P3/2: M1/1)

A total of 30 teeth in the normal cat.

Description of each tooth may be added by describing first left or right (L/R) then upper or lower (U/L) then the tooth type & number. Eg LLPM4 = left lower 4th premolar.

Modified Triadan System

This also describes teeth. It uses numbers only and is the classification on most dental charts.

Each tooth is assigned a three digit number eg 104

The first number denotes quadrant of the mouth (ie left or right, upper or lower section) in which the tooth lies.

1= right maxillary

2= left maxillary

3= left mandibular

4= right mandibular

The second number eg '04' of 204, denotes the specific tooth and position.

Certain teeth may be useful to act as locators:

Canines- always end in '04'

1st Molars- always end in '09'

Thus the number '109' would refer to RUM1 (right upper 1st molar), '304' refers to the left mandibular/lower canine (LLC).

Species Differences

In different species the number of tooth types varies.

In considering canine and feline patients, the modified Triadan system is used, but some numbers will be missing as these teeth do not exist in that species. The teeth present do not change number however; canines are always '04', 1st molars always '09'.

Similarly, if an animal has extractions, we do not re-number the remaining teeth!

Eg Feline:

2x (I3/3: C1/1: P3/2: M1/1)

Note the low number of premolars and molars compared to the dog.

The cat is a true carnivore. It has evolved to have only those teeth essential to groom, catch prey and cut food. It has fewer teeth than the dog and only one flat-surfaced molar in each side of the maxilla. The cat does not have 105,205,305,306,405,406 thus numbering reads eg 104 followed by 106 (ie RUC followed by RUPM2) or 304 followed by 407 (LLC followed by RLPM3).

Eruption Times

DOG

Eruption times vary. Below is a general guide to time range:

	DECIDUOUS	PERMANENT
INCISORS	3-5weeks	3-5months
CANINES	3-5weeks	4-6months
PREMOLARS	4-6weeks	4-6months
MOLARS	-	4-7months

CAT

Eruption times vary. Below is a general guide to time range:

	DECIDUOUS	PERMANENT
INCISORS	2-3weeks	3-4months
CANINES	3-4weeks	4-5months
PREMOLARS	3-6weeks	4-6months
MOLARS	-	4-6month

Since the deciduous teeth shed and permanent teeth erupt ('succession') over different time ranges for each tooth type, puppies and kittens often have both deciduous and permanent dentition present at any one time. This is known as 'mixed dentition'.

Prior to the time when the permanent, adult dentition erupts only deciduous teeth can be seen. The developing, permanent teeth ('buds') are present - hidden within the bone. These teeth can thus be damaged before they erupt or are seen.

Deciduous teeth have thin, fragile roots. Prior to the time when the permanent, adult dentition is due to erupt these thin roots begin to disappear.

This 'programmed resorption' allows the primary teeth to shed ('exfoliate') easily and allow normal eruption of the permanent dentition.

The immature, permanent tooth has thin walls and an open root tip or 'apex'.

The pulp is wide and the tooth is fragile. As the animal and its teeth mature, dentine is laid down. The walls thicken and the space for pulp narrows with time. The root apex closes gradually, eventually (typically 18mo) leaving only tiny holes for vessels to enter and exit; this is the 'apical delta'.

Occlusion

An animal's 'bite' or way the upper and lower jaws meet is known as the 'occlusion'. The relationship between the jaws should be balanced in the natural 'mesocephalic' situation eg beagle. Normal occlusion creates a comfortable and functional bite to allow unhindered eating and grooming.

Oral & Dental Investigation

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The high prevalence of dental diseases is well accepted. The significance of this to our patients is marked and choosing appropriate treatment is essential. To effectively identify pathology types, severity and location thorough oral investigation is required. Minimal investment in equipment, man-power and time is needed to vastly improve our diagnostic work-up.

The results should be analysed both as a general view of the animal's oral status and on an individual tooth-by-tooth basis. The notion of each tooth being regarded as an individual patient is a useful one. The findings for a mouth, and the dentition within, will commonly span a number of pathologies and potential treatments. Assessing each while also balancing client expectations, compliance and patient factors guides treatment.

The components of investigation are:

- History
- Clinical examination (conscious)
- Pre operative testing
- Exam under GA - probe & chart
 - intra-oral radiography
 - biopsy

History

A thorough history is required to assess the nature, pattern, location and progression of any presenting problem. Indicators for other disease processes and potential anaesthetic and medication implications are explored. At this stage the wishes and concerns of the client are also often evident. It is important to gauge what client compliance (eg to homecare) may be expected.

Clinical Examination

This should involve the entire animal, including cardio-vascular and respiratory parameters, with focus on the mouth and teeth as the final part of examination.

Inevitably general anaesthetic is required for full oral examination and safety is thus paramount.

Head examination includes:

- General shape & symmetry
- Lymph nodes & salivary glands
- Mucous membranes ; including colour & CRT
- Globe retropulsion (gentle!)
- Muco-cutaneous border examination
- Oral examination - teeth: colour, shape, missing teeth, abnormalities
- soft tissues: lips, cheeks, tongue

Proceed with caution in animals with uncertain nature!

Oral assessment in the conscious animal is always compromised and may be useless as well as dangerous in a fractious animal. Ensure safer and more thorough investigation by advising anaesthesia if in doubt!

Conscious Oral Examination

Technique relies on firm but gentle handling in the following order:

- Mouth closed, anterior cheek teeth (labial surface, premolars & canines)
- Mouth closed, posterior cheek teeth (buccal surface, premolars & molars)
- Mouth closed, mesial teeth (incisors & canines)
- Mouth open, posterior then anterior teeth (lingual, palatal & occlusal surfaces)

This order progresses from the most to least tolerated mouth manipulations; a growl at any stage should halt the process at that point!

The posterior cheek teeth may be clearly viewed despite cheek tissue as this is normally very elastic and may be retracted adequately at the commissure of the lips.

The pathology noted at this stage is likely to be only part of the true picture. This should be explained to the owner. However, the pathology noted (or any unidentified oral discomfort/ signs) act as the 'admission pathology' for general anaesthesia, thorough investigation and thus ability to gain the full picture.

Pre-Operative Tests

These 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. Most typically one may consider the effects of bacteraemia. Other complex relationships also exist and 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).

Testing considered:

- Biochemistry
- Electrolytes
- Haematology
- Urinalysis (dipstick & refractometer SG)
- Viral testing – blood eg FeLV, FIV
- oral swab FCV, FHV

Oral disease is disease! Where unusual or advanced disease pattern is noted testing is advised eg 3yr old Labrador with severe periodontitis.

Assessment Under General Anaesthetic

Full oral assessment requires general anaesthesia:

- Operator safety – sedated animals may still bite (you & films/ sensors!)
- Patient safety – protection of the airways; especially with liquids usage
- Examination quality – enables more thorough examination
- Treatment – treatment required, including surgery, may be performed

General oral view

The opportunities to obtain an 'overview' of the mouth prior to intubation should not be missed! This is especially true for fractious animals where conscious view may be impossible and for occlusion assessment.

Induction: Accurate assessment of occlusion cannot be performed in the intubated animal. The tongue must also be temporarily tucked back into the oropharynx in these

cases. Ensure adequate anaesthetic depth for operator safety and pre-oxygenation for patient safety first!

Intubation: Good opportunity for examination of the oropharynx, tonsils, epiglottis & fauces.

Chlorhexidine 'Prep': This is performed once the patient is established as stable under general anaesthesia. Topical antimicrobial activity creates a safer and more pleasant environment for both patient & operator. During application teeth are over-viewed and all soft tissues are examined. This includes all surfaces of:

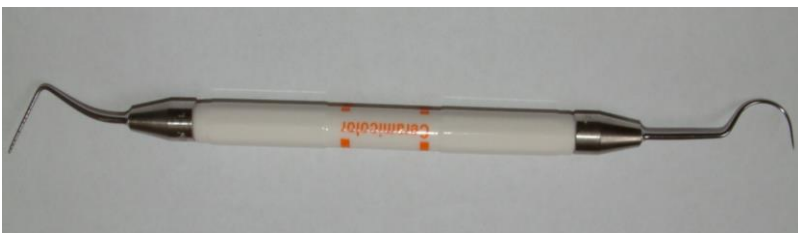
- Lips
- Vestibules
- Tongue
- Palate
- Cheek-lining mucosa
- Fauces and tonsils

Probe & Chart

The initial stage of detailed patient assessment, once under general anaesthetic is probing and charting. This requires:

- **periodontal probe** (depth gauge) - rounded tip: soft tissue evaluation
- **explorer probe** – sharp tip for hard tissue tactile investigation
- **dental chart** - 'dentition map'

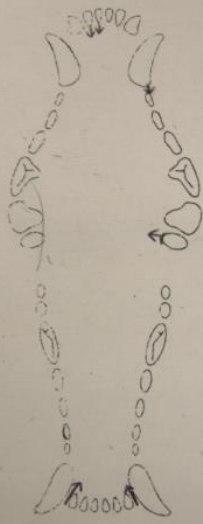
It is essential that all findings are accurately documented for diagnostic, monitoring and medico-legal purposes.



Periodontal & explorer probe

Dental chart: use writing and drawing space to note all findings in detail, many diseases are site specific, which affects prognosis

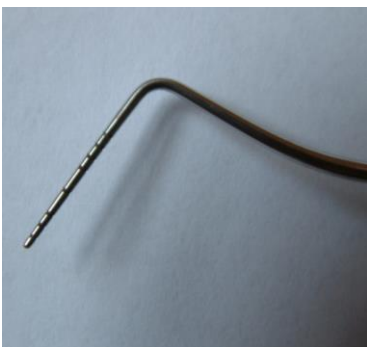
G2	101 PD4
G2	102 GR1 PD3
G2	103 GR2 PD3
G2	104
G3	mi GR3 PD2
G3	106 F3
G3	107 F3
G3	108 F3
G3	109 F1
G2	110 F2
RHS	
G2	111 PD4
G3	112 PD4 F3
G3	113 F2
G3	114 F3
G3	115 F2
G3	116 F3
G1	405
G3	404
G3	401 PD5
G3	402 PD3
G3	403 PD3
G2	201 PD4
G3	202 GR2 PD3
G3	203 GR3 PD3
G3	204 GR1 PD4
G3	205 mi
G3	206 F3
G3	207 F2
G3	208 F2
G2	209 F1
G2	210 PD3
LHS	
G2	211 PD4
G3	212 F2
G3	213 F2
G3	214 F2
G3	307 F1
G2	306 F3
G1	305
G3	304 PD5
G3	303 m2 PD4
G3	302 m2 PD4
G3	301 m2 PD4



Dental chart

Investigation should be carried out in a methodical, sequential manner. Begin at the front of the mouth and work backwards (caudally/ distally) in a tooth-by-tooth fashion. Repeat for each quadrant of the mouth. This is more thorough and actually faster than 'jumping around the mouth'.

1. Periodontal probe: has millimetre delineations to enable measurement and a smooth tip for use on soft tissues. A pattern with delineations close together (eg Williams) enables more accuracy of measurement.



Periodontal probe detail - note millimetre delineations

This instrument is used for every tooth **and** over edentulous areas with any signs of inflammation. It gives information regarding:

- Gingivitis – severity (bleeding tendency: score 0-3)
- Periodontitis - Pocket depth (mm)
 - Gingival recession & root exposure (mm)
 - Furcational bone loss (score 0-3)

- Mobility (score 0-3)

- Lesion quantification – stomatitis & ulceration surface area
 - epulides: hyperplasia to melanoma!
 - measurement and associated damage
- Fracture depth (mm)
- Tract detection & exploration - eg abscess, root remnants

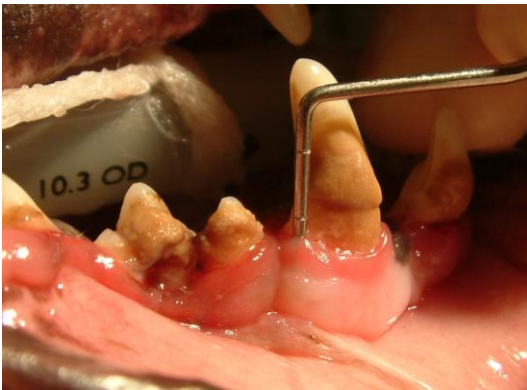
Technique:

- Insert the periodontal probe is inserted into the sulcus
- **gently** advance vertically
- **stop** when light pressure is resisted by attachment tissues
- guide the probe around the tooth circumference 'feeling' for this 'stop'

Any abnormalities eg bleeding, increased probing depth via pockets or gingival hyperplasia (overgrowth) are noted.

Caution: excessive force will damage attachment tissues and give inaccurate readings.

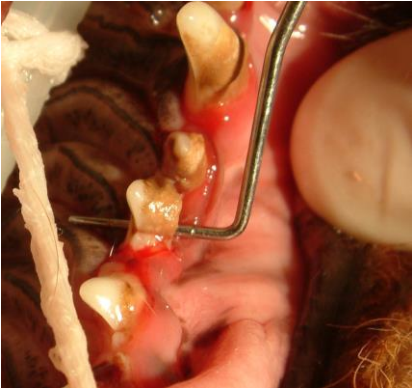
Periodontal probe inserted into the sulcus then guided around tooth.



In the case of multi-rooted teeth the probe is used to assess the amount of bone present in the furcation (space between roots of an individual tooth).

Furcation assessment is performed by:

- insert probe into the sulcus as above
- attempt gently angling the probe perpendicular to the tooth at the furcation
- assess whether the probe can be inserted to any depth between roots
- repeat for all furcations from all aspects



Use of the probe in a periodontitis case: furcation exposure (F3)

Mobility assessment is performed by:

- the end of two probes placed on either side of the tooth
- gentle pressure applied to tooth
- assess movement in each horizontal plane
- assess movement in a vertical (out-of-socket) plane

2. Explorer: The sharp-tipped explorer is used **ONLY** on hard tissues. It gives visual and tactile information plus an audible metallic 'ting' on catching a rough edge of enamel.

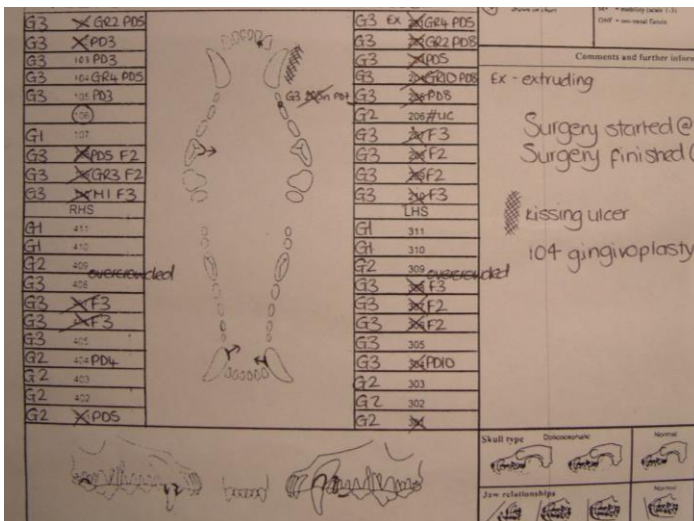


It is used primarily to aid diagnosis of:

- Fractures - including enamel chips & hairline fractures
- Resorptive lesions - including those just subgingival (care!)
- Caries - like pushing into rubber or old chewing gum!
- Restoration flaws
- Pulp exposure - eg via tooth wear (abrasion or attrition)

3. Charting: Ensure that all abnormal findings are recorded on the chart and, where possible, give details including location, severity, size (mm) & direction. Examples include:

- Periodontal disease
- Missing teeth
- Damaged teeth
- Abscess & tracts
- Resorptive lesions
- Caries
- Oral masses
- Pre & Post Tx eg extraction



Filling in the Chart & Disease Scoring

Most charts have a key to aid appropriate indication of pathologies and treatments.

Some common examples are:

- Missing tooth – circle tooth number
- Caries – CA
- Tooth resorption (resorptive lesion) – TR
- Fractured tooth - #
- Extract tooth – single oblique line through the tooth number to identify pre-extraction, finalised as a cross on completion of extraction.

The majority of periodontal pathology is described by millimetre measurement as noted previously. However a grading system exists for many pathology types eg furcational bone loss via periodontal disease and tooth mobility.

Furcation score:

- Grade F0 = normal
- Grade F1 = <33%
- Grade F2 = >33%
- Grade F3 = 100%

Mobility score:

- Grade M0 = normal
- Grade M1 = horizontal movement \leq 1mm
- Grade M2 = horizontal movement $>$ 1mm
- Grade M3 = vertical & horizontal movement
or
(multi-rooted) horizontal movement \geq 1mm

Calculus and plaque indices are not required- although some advocate their inclusion the fact that these parameters are not in themselves disease, are expected to be present and will be removed causes this author and many colleagues to view this as unnecessary. One may make a note of general pattern if desired which may be of assistance regarding homecare guidance. It is likely however that gingivitis and other periodontal health indicators would fulfil this role.

Making the Chart Work

Thorough probing and charting of the resultant information is extremely efficient. A completed chart negates the need to then keep rechecking the probing – trust the chart and use it as your guide! This does of course make doing it correctly the first time critical!

The finished chart should be archived with any associated material eg laboratory results, history, dental radiographs in a clear wallet within a ring-binder arranged in chronological order. Correctly completed charts have multiple benefits:

- Efficient - maximal information in minimal time & writing
- Permanent record – no memory required!
- Educational tool for clients and colleagues
- Monitoring
- Medico-legal document

Radiography

Intra-oral radiography is mandatory for full diagnostic investigation. Omission of radiography will result in the operator missing enormous amounts of pathology, as the roots remain invisible. Clearly this is of detriment to patient, client and practice alike. Human dental films or digital dental sensors should be used. Normal Xray generators can be utilised but a dental Xray generator gives great benefit in speed and ease of use. This equipment is relatively cheap and investment in it and learning intra-oral radiological (bisecting angle) technique will pay dividends.

Biopsy

Biopsy should be performed for ***all*** masses & abnormal lesions!!!

The information you gain from the histopathologist is essential but only as good as the sample you send. The following steps should be adhered to in order to obtain a good and diagnostic sample:

- Wedge biopsy
- Avoid tissue heating & trauma
- Sufficient size
- Adequate depth – including underlying bone where relevant
- Avoid ulcerated / inflamed areas – this compromises interpretation
- Label / orientate on dental chart – ensure you can identify in retrospect!
- Twin with radiography – where a mass is near any underlying bone
- Oral pathologist – try to send to one with an interest in oral pathology
- Discuss, refer, resample - if the results don't match the clinical picture

Summary

It is this investigatory information which, combined and considered, will determine what diagnosis made and thus what treatment is elected. The quality of the information is therefore critical to outcome success and ultimately patient welfare. Error or complacency at any stage will produce a 'domino-effect' leading to potentially wrong or compromised treatment. Ensure that a meticulous and thorough investigatory approach is used in every case.