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Improving Your Equine Dentistry Mini Series

Session One: Equipment for Modern Dental practice and the Oral Examination

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Equipment for Modern Dentistry; Use of Sedatives; The Oral Examination

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Introduction to Modern Dentistry

Modern routine dental care can be considered to constitute the following procedures:

- Clinical examination
- Extra-oral head examination
- Intra-oral examination of dental and non-dental tissues
- Charting of signalment, history, findings and recommendations for further treatment
- Maintenance rasping of buccal and lingual points
- Rostral profiling of 06 teeth (if considered necessary)
- Corrective odontoplasty of focal overgrowths (usually minor)
- Basic management of periodontal disease or other pathology

The emphasis for veterinary surgeons performing equine dentistry should be performing an accurate detailed clinical examination, recording findings, carrying out treatments thoroughly and safely. The practitioner should discuss clinical findings (including pathology such as sharp enamel points, focal overgrowths, dental caries, diastema and periodontal disease) with the owner and make recommendations on further treatment.

Equine dentistry in veterinary practice should be a team effort with all members of the practice well versed in the practice's approach to dentistry, which will be to provide a modern clinical service based on early identification of disease and a move towards preventative and conservative treatments. This will likely not be possible with the traditional 'dentist's' approach of performing dental rasping in unsedated horses with minimal or no examinations. It may be that the practice requires reception training to ensure that a positive message is conveyed to clients. Recent polls and mystery shopper reports from 'On-Switch' have shown very poor results for equine practices with few telephone requests for dental information and pricing converted into appointments by practice receptionists. The practice policy on dentistry should cover:

- Services provided – routine only / internal referrals /EDT referrals /vet referrals
- Equipment level for vets – manual vs power instruments, diagnostic equipment
- Working practices – sedation?, stables, clinic
- Practice approach for EDT sedation – BAEDT only? Price for sedation and observation?
- Referral strategy for complex case – visiting specialist or referral centre?
- Marketing of practice dentistry services
- Future vision – 2yrs, 5yrs, 10yrs

Equipment for Modern Equine Dentistry

1. *Oral Examination*
    - Head support – stand, hoist
    - Speculum – horse + pony
    - Dental buckets x 2 or organiser + bucket
    - Dental Syringe + mouthwash
    - Bright headlight and/or intra-oral light
    - Oral / Dental examination instruments
        - Mirror
        - Occlusal explorer
        - Periodontal probe
        - Scaler
        - Incisor explorers

- Cheek retractor
- Intra-oral camera / dental endoscope / oroscope
- Light source
- Image / video recording
- Flexible endoscope – endoscopy / sinoscopy
- Radiography
- DR / CR
- Safety equipment

2. *Routine Maintenance Dentistry*
    - Electromechanical dental burs, discs, burs, 'apple cores'
    - Water cooling option
    - Manual floats
    - General floats
    - Slimline U11 float
    - S-float
    - Cap extractors – upper / lower
    - Local anaesthetic syringe + 27-30G needles
    - Wolf tooth extraction instruments / luxators
    - Wolf tooth forceps

3. *Periodontics*
    - Diastema forceps – straight / angled
    - High pressure diastema pump- electric / manual
    - K-files or H-files + Haemostats / holders
    - Straight needle explorers (for I/P space)
    - Diastema widening hand-piece
    - Diastma widening burs (3-6mm) – cone, cylindrical
    - Vinyl polysiloxane impression material
    - Self bonding cement / crown restorative
    - 'Periodontal / Endodontic unit' – see Endodontics

4. *Extraction*
    - Dental anaesthetic syringe + 27G needles
    - Molar spreaders x 2-3
    - Molar extraction forceps – as many as possible
    - Dental fulcrum various sizes
    - Fragment forceps – as many as possible, varied lengths
    - Angled luxator / elevator set, various lengths / angles
    - Incisor luxators / gouges / chisels + mallet
    - MTE equipment
    - Sinosotomy trephines / drills
    - Dental punches – MIR kit
    - Alveolar packing material

<u>Routine Dental Care</u>

Routine dental care is best performed in an enclosed space e.g. stable or stocks, with subdued lighting to allow optimum illumination of the oral cavity. Water and electricity should be on hand with due regard to electrical safety. A dry working area free from obstacles and obstructions, with clear space either side is recommended. An adjustable loose fitting head collar may be a useful investment in case one is not available. An instrument holder / organizer is useful and may be a stainless steel bucket with hollow tubes ('blade savers') or a simple table or trolley for disposables and other items.

The author sedates all horses for routine dentistry but consideration should be given to restraint in all cases e.g. competent handler, is the handler to be present in the stable (not recommended if unsedated). Use of a twitch for restraint for dentistry is NOT recommended due to the instrument being in the way of clear access to the mouth, risks personal injury, and there is potential for severe adverse reactions when used for prolonged time (e.g. crib-biters, windsuckers due to increased opiate receptor stimulation and resultant severe excitement).

A head-stand or dental suspension halter is considered essential for routine work. It is unacceptable and potentially dangerous to ask owners to hold up a horse's head for dentistry, and difficult to perform a thorough job if the head is down, unrestrained or if being held simultaneously by the operator. Head stands are preferable in most situations unless a purpose designed support is available for a suspension halter positioned immediately above the head position, and even then a head stand is recommended in addtition. Use of a nearby beam in a stable is not recommended for head suspension. A solid cushioned bar also works well as a head support and in the absence of anything else a cushioned top of a stable door or upturned broom may be suitable.

Maintenance rasping of sharp enamel points

The main decision here is if routine rasping of sharp enamel points is to be performed using hand or power instruments. Partly this is personal preference however there is increasingly a trend towards the careful use of power instruments under light sedation and direct visual guidance for routine work. It is recommended that power work should only be performed under sedation, however although not recommended, anecdotally in certain circumstances there may be occasions where unsedated power work is tolerated. Modern powered instruments are lightweight, versatile, mains or battery powered and increasingly reliable. Many now also have the option of water irrigation and vacuum. Cost will always be a consideration, however the author considers it essential now for routine work that power equipment be available for careful overgrowth reduction and therefore it is worth considering use of that instrument for routine rasping of enamel points in addition to focal overgrowth reduction.

Hand instruments

For hand rasping, a selection of lengths and head angles should be used with solid carbide blades set to cut in a direction least likely to cause soft tissue trauma e.g. set to cut on 'push' or 'pull' stroke for rostral teeth, but set to cut on 'pull' stroke for caudal teeth. Blades should be sharp and clean, and replaced as soon as there is the suggestion that they are becoming blunt. Solid carbide blades should either be sent for periodic re-sharpening, or replaced with new disposable types e.g. titanium nitride coated for extra resilience. The angle of the head is also critical for ability to properly access all areas of the mouth, and the shortest length of shaft possible for the area to be rasped will increase efficiency. Grips on hand instruments may be straight or pistol grip. A suggested list of hand rasps may be as below:

- Short 15-30° obtuse angled rasp – for upper 06, 07
- Medium 15°-straight rasp – for upper 08/09, lower 06. 07, 08
- Long 15° angled (closed angle) rasp – for upper 10,11
- Short straight rasp – for lower 06,07,08
- Long straight rasp – for lower 09,10,11
- 'Gledhill' rasp – for lower 09,10 ('Curve of Spee')
- Table float e.g. carbide chip or diamond 'S' float (medium-large not the little tiny one)
- Premolar rasp – for rostral profiling 06s

Power instruments

These now come in a variety of forms and options/factors to consider are:

- Axial rotating burr vs disc set at 90°to shaft
- Options for interchangeable heads e.g. diastema burr / 'apple core' fittings
- Battery vs mains power (110V required)

- Weight of operating handpiece (keep light to combat repetitive strain injury e.g. rotator cuff)
- Cable system with remote engine and control vs instrument mounted motor
- Water irrigation/cooling option
- Vacuum option
- Cost / availability of servicing / after sales support
- Reliability
- Axial drive carbide bur systems
    - less easily available in the UK
    - clutch to prevent severe trauma if tissue caught
    - Increased potential for 'snagging' soft tissue between the guard and the disc
    - Require foot pedal operation
    - Dremel motor not supported by manufacturer for dental use
- Disc based instruments
    - Clutch to prevent trauma or instrument damage
    - Possible more dust produced – health and safety consideration

Fig.1 Correct use of modern equipment for sustainable routine equine dental care. Note headstand, stool, bright headlight, motorized instrument, scrub top, gloves, speculum with wide incisor plates. A dust mask and eye protection should also be considered.

Traditionally axial burrs (e.g. GT systems) were popular with a separate handpiece connected via a flexible shaft to a mains powered motor (e.g. Dremel or Suhner). These are still used today however most require foot pedal operation which is a further complication which some find inconvenient to operate especially when learning. Modern cable shaft drive systems use a lightweight waist mounted battery or mains powered engine with disc or axial drive handpieces that are easily interchangeable and are lightweight and flexible (HDE Evolution, Dearson, PZ Holger Rosenburg). There are also systems available with motor, water pump, vacuum and light source all based in a remote box connected via linked cables to the handpiece (Flexifloat, Capps).

Other systems use replaceable carbide chip or diamond discs on an 'all-in-one' unit similar to a modified hand drill (Powerfloat, HDE Float).

Water irrigation for handpieces is becoming increasingly available (Flexifloat, Dearson, PZ).

Common systems available are:

Axial drive systems:

GT / Carbide products	http://horsedental.com/float_motors.html
Capps manufacturing	www.cappsmanufacturing.com

Disc or interchangeable systems:

HDE / Equine Blades Direct	www.equinebladesdirect.com
Powerfloat	http://www.powerfloat.net/Order/order_eu.html
Dearson Equine	www.dearsonequine.co.uk
Flexifloat	www.vdpeurope.com
Capps manufacturing	
PZ Technic GMBH	http://www.pz-technik.de/pz/en/home.php

Other useful items for routine work

The following is a list of some additional items that may be useful stable-side when performing routine dentistry:

- Picnic table, foldable trolley, golfing buggy or bespoke dental trailer
- Overalls / scrub top
- Adequate supply of syringes, needles, sedatives, analgesics
- Mouthwash concentrate
- Wolf tooth extraction instruments
- Dental chart box, or zip-lock folder and clip-board
- Pens that work
- Latex or nitrile disposable gloves
- Roll of paper towel
- Spare batteries for head light
- Face masks / filters
- Safety eyewear
- Waste bin for clinical and non-clinical waste
- Sharps bin
- Instrument disinfectant
- Client information leaflets
- Basic tool kit for power instrument maintenance
- Lubricant for power instrument
- Packed lunch / fruit / chocolate bars

<u>The Use of Sedatives in Equine Dentistry</u>

The use of sedatives for surgical, medical and diagnostic procedures is now accepted as a standard procedure to allow a safe, thorough procedure to be performed in the standing horse without need for general anaesthesia. It also has the advantage of providing some analgesia to the patient, and provides increased safety for the operator.

The continued advance of research into dental disease and available treatments means that it is imperative that a veterinary surgeon called to examine a horse's mouth conducts a thorough and detailed clinical examination. This means the use of mirrors, picks and probes to identify and assess pathology as well as the traditional dental palpation for sharp points and obvious abnormalities. Following this examination, routine and remedial work is increasingly carried with motorized instruments under careful visual control. In addition, there may be procedures that are carried out at the time such as removal of food material trapped in diastemata and flushing of periodontal pockets that may be painful.

If the practitioner is to perform a high standard of clinical dentistry, the author recommends aiming towards a 100% sedation policy for all dental procedures. The small increase in cost will easily be rewarded by increased client satisfaction through more interaction in safety, increased diagnostic ability, improved dental treatments performed at the time and increased numbers of cases referred to the clinic for further investigation or treatments.

Alpha-2 agonists
Alpha-2 agonists are very suitable for routine dentistry providing reliable short term dose-dependant sedation and good analgesia. Standard drugs will usually be xylazine, detomidine or romifidine administered with or without an opioid such as butorphanol. The duration of sedation with different α-2 agonists varies; romifidine provides the longest effect and xylazine the shortest. All take about 3mins to take effect and it is recommended to wait until the full effect has taken to begin any procedure. The dose range is quite broad, however they do have a 'ceiling of effect'. Dosages above the 'ceiling' will usually prolong the duration of action and increase the untoward side effects such as ileus and ataxia (although the latter is much less marked with romifidine). Further does may be administered if required at 20-30 minute intervals. If prolonged sedation is likely to be required a continuous infusion regimen is recommended (see later).

Opioids
Opiods act in a similar way to morphine effecting specific opiate receptors and provide potent analgesia. When used in combination with α-2 agonists the sedative effect is more reliable and analgesia increased. However, there may be some excitement, possibly manifested as 'twitching' when used which in many cases may be reduced by administering the opioid a few minutes after the α-2 agonist. Many practitioners use butorphanol for routine use, however morphine is the gold standard opioid analgesic against which others are compared and is the opioid of choice for prolonged or more painful procedures and is increasingly being used as part of a balanced anaesthesia
Protocol in many equine hospitals.

Dose rates for α-2 agonist / butorphanol combinations

Xylazine i.v. at 0.5-1.0mg/kg bwt (0.5-1.0 ml 10% solution per 100kg)
or
Detomidine i.v. at 0.01-0.02mg/kg bwt (0.1-0.2ml per 100kg)
or
Romifidine i.v. at 0.04-0.1mg/kg bwt (0.4-1.0ml per 100kg)

plus
Butorphanol i.v. 0.01-0.03mg/kg bwt (0.1-0.3ml per 100kg)

Domosedan Oral Gel
Detomidine is now available and licensed for use in horses as an oral gel formulation. This product is a prescription only medicine and as such has to be dispensed for use in a specific horse for a particular condition and cannot be issued to owners for use 'as and when' required e.g. for sedation for an equine dental technician when next on the yard. It is acceptable to be dispensed for this purpose on a particular occasion, but not for 'general use'. Also an operator wearing impervious gloves must administer it under the tongue of the horse.

Acepromazine
Acepromazine maleate, a phenothiazine is most commonly used as a premedicatn agent prior to anaesthesia, however may be used prior to standard sedation to enhance or prolong the action of the α-2 agonist. Ataxia may be produced and consideration should be given to the (small) risk of paraphimosis or priapism (Driessen *et al* 2010).

Acepromazine may be used prior to sedation at a dose of 0.04 mg/kg i.v. or i.m. There is evidence that acepromazine reduces the excitatory effects of opioids.

Continuous rate infusion (CRI)

Prolonged standing procedures such as dental extractions per os are better performed using CRI than intermittent bolus of sedation. CRI allows more accurate titration of agents, more constant plasma drug concentrations, and more consistent analgesia and sedation for prolonged periods.

Xylazine infusion
Loading dose xylazine 0.5 mg/kg bwt i.v.

- Add 500 mg xylazine to 500 ml bag saline.
- For 500 kg horse start at about 2 drops/s (approx 12 **µ**g/kg bwt/min).
- Titrate infusion rate to achieve desired effect.

Detomidine infusion

- Loading dose 6 **µ**g/kg bwt detomidine i.v.
- Add 12 mg detomidine to 500 ml bag saline.
- For 500 kg horse start at about 4 drops/s (approx 0.1 **µ**g/kg bwt/min).
- Titrate infusion rate to achieve desired effect.

Ketamine infusion
Ketamine, mainly used as an induction agent, produces intense analgesia and is used in human medicine at sub-anaesthetic doses for pain management in trauma patients. When used alone, it can cause excitement reactions and therefore should always be used in combinations with other agents (e.g. α-2 agonists). Ketamine may be administered as a bolus, or preferably in combination with a CRI protocol. Care should be exercised as ketamine may cause profound ataxia in combination with α-2 agonists.

- 500 mg ketamine in 1 litre saline.
- 1 drop/s and alter accordingly.
- May get excitement reactions – pre-med with ACP and use in combination with above.

Lignocaine
Lignocaine infusions are used in the perioperative period for their anaesthetic sparing, prokinetic and analgesic effects. The analgesic effect could also be utilised to improve surgical conditions in the standing horse. Furthermore, there is evidence that lignocaine has some sedative and muscle relaxation properties.

<u>The Oral Examination and Equine Dental Endoscopy</u>

A good thorough oral examination is of utmost importance to performing quality equine dentistry. Advances in knowledge of dental anatomy and pathology have led to an increase in the diagnostic information provided by visual inspection of the dental arcades and oral cavity. The equine oral examination should start by recording the clinical history and signalment on a dental chart. This is followed by an external examination of the head noting symmetry, soft tissue swelling, bony masses or depressions perhaps suggesting previous sinus surgery. Manual palpation of the interdental space and the bars of the mouth may also be performed at this stage.

Examination of the incisor teeth is commonly overlooked but should always be performed before placing the speculum for intra-oral examination. In addition to assessing the presence or absence of teeth, approximate age of the horse and any pathology, the lateral excursion to molar contact test (LMC) may be used to assess for masticatory symmetry and suspected oral or dental pain.

Direct intra-oral examination using a bright head torch, speculum, mouthwash and manual retraction of the tongue will yield useful information regarding pathology in many cases e.g. food material may be seen protruding from interproximal spaces, suggesting a diastema. However because of the limited opening of the equine mouth, and the rostral arrangement of the lip commisures, much of the oral cavity, especially the buccal and lingual aspects of the dental arcades are not visible directly from a rostral position.

The only way to visually inspect the otherwise inaccessible areas of the mouth is by using a dental mirror or a dental endoscope.

In human dentistry it is commonplace to use an ‘arcade mirror’ which has 2-3 small mirrors allowing visualisation of the lingual, buccal and occlusal surfaces simultaneously. The larger equine teeth, mobile tongue and often limited space mean that only one aspect of the teeth is examined at once using a simple mirror. Mirrors are usually circular and rigid enough to be used to retract soft tissues during examination.

Dental endoscopes can provide very detailed and highly magnified images of the oral cavity, and are especially useful for small defects in the occlusal surfaces. Any aspect of the mouth or teeth can be imaged using an endoscope, with the magnified image enabling more sensitive detection of dental pathology such as dentinal fissures, pulp defects, periodontal disease, caries lesions and any soft tissue lesions. Most endoscopes using a chip to grab the image will display the image on a screen that is a great advantage when explaining and demonstrating pathology to clients.

Increasingly commercially available systems are available giving practitioners the choice of traditional analogue systems or more compact digital systems. Human dental intra-oral cameras may also be used, however these are usually short in length, not robust and the author has no experience in their use.

Dental endoscopy can be performed with either a flexible fibre-optic or video-endoscope or with a rigid telescope such as an instrument designed for human laparoscopy. Flexible endoscopes give satisfactory pictures, but the soft PVC sheath protecting the electrical and optical components can be damaged easily by sharp dental prominences with the result that sterilizing the endoscope becomes difficult and moisture leakage into the sheath can result in fogging of the lens.

Rigid telescopes come in various lengths. A 40-50cm rigid endoscope or borescope with a 50 to 70° viewing angle is ideal (e.g. Storz borescope, Fig.2) The durability is improved if the telescope is protected in a stainless steel sheath. An additional outer plastic sheath is a useful addition to dampen any vibrations when the telescope contacts the rostral teeth during examinations. The telescope is then coupled to a chip camera and monitor or laptop (Fig.2) to enable viewing and recording of the images (Fig.3).

Fig.2 Storz borescope 43cm, 70^{o} view dental endoscopy system

Fig 2. Instructional leaflet for Fiegert Endocam II digital image capture camera system

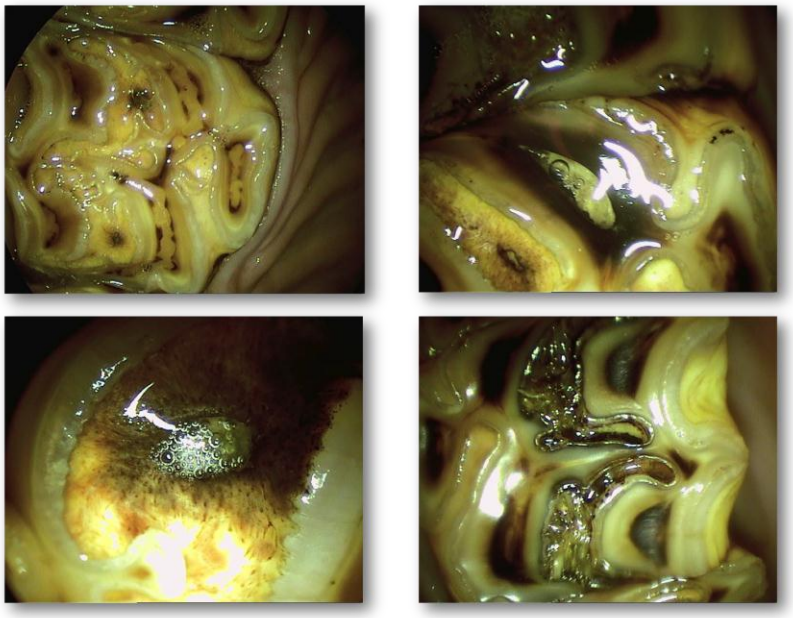

Fig.3 Oroscopic imaging allows detailed oral examination and recording of findings

Modern digital systems (e.g. Fig.2) negate the need for bulky individual components such as light source, image converter, recording system, viewing station. The newest systems operate directly via USB using a digital imaging chip within the C-mount camera head. Compact bright LED light sources are also now available either battery or USB powered. Portability is significantly increased with USB systems as the camera is connected directly to a laptop computer without the need for a separate image converter.

Images are either recorded onto a separate image / video recording device, or with modern USB systems directly using a variety of medical or standard video capture software (e.g. NCH Debut, MedicalEDA). Dental charting is still important for instant recording of major findings, and increasingly digital charts e.g. pdf based iPad systems are available.

Restraint
Horses should always be sedated for oral endoscopic examination (e.g. alpha-2 agonist with or without an opioid), preferably with the horse's head resting on a padded headstand, or suspended from a dental halter. Additional relaxation can be provided using 5-10mg diazepam i.v. which may aid relaxation of the tongue.

Technique
Oral examination should always be preceded by washing the mouth out thoroughly, and performing a standard oral examination using a dental mirror. The author prefers to begin by examining the 106 tooth occlusally, progressing to the 111, then repeating this examination process for the buccal and palatal aspects of the arcade, particularly noting the health of the interproximal spaces, and observing for diastema. Any occlusal defects that are identified may be probed using a fine occlusal explorer guided visually using the oroscope. Similarly periodontal pockets may be probed for depth and observed visually after removal of food and flushing with a water pick. Any findings are then recorded before moving on to examine the 206-211 arcade. For examination of the mandibular arcades the camera is rotated 180 to facilitate spatial awareness for the operator.

Occlusal Anatomy
Understanding the normal anatomy of cheek teeth is imperative in order to be able to obtain useful clinical information from an oral examination. Many teeth will show signs of early pathological change in advance of other clinical signs developing and identifying this pathology is the basis of modern equine dentistry. Whilst this article is not aimed as a full anatomical text, the images below show basic important anatomical features.

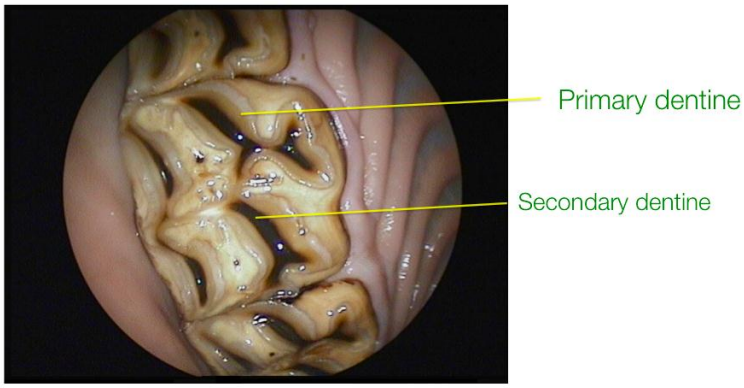

Fig 4. Occlusal surface of maxillary cheek tooth showing different appearances of primary and secondary dentine.

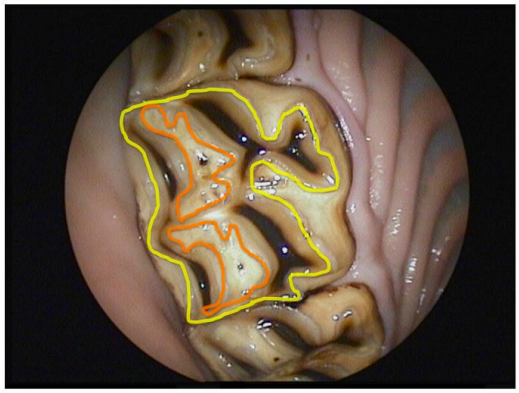

Fig 5. Occlusal surface of maxillary CT: peripheral enamel outlined in yellow, infundibular enamel outlined in orange

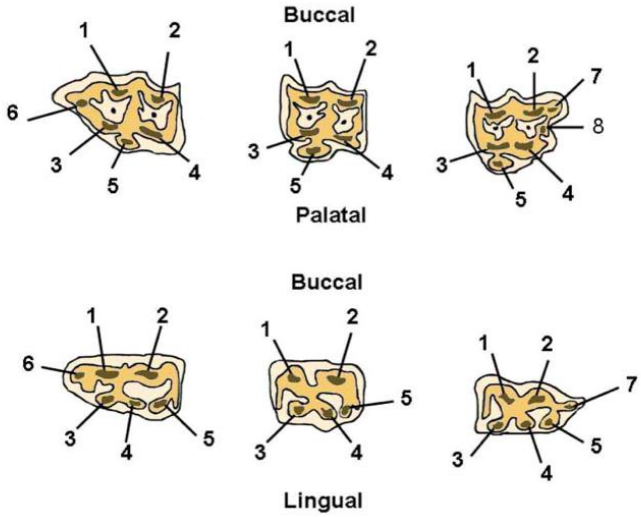

Fig 6. Pulp numbering system (DuToit 2008)

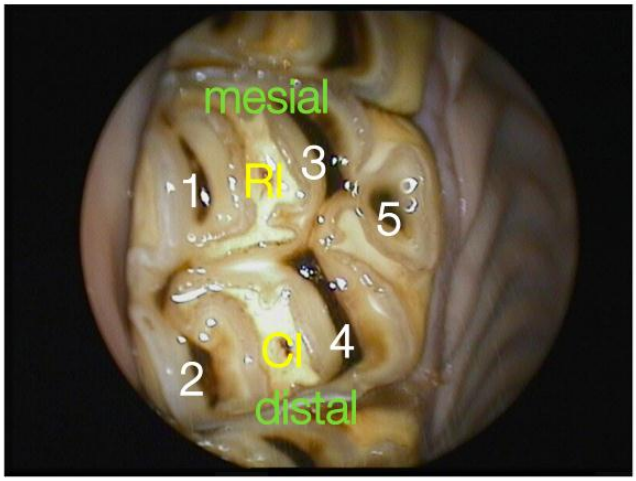

Fig 7. Occlusal surface of maxillary CT; 1-5, numbering system (1-5, DuToit 2008); RI, rostral infundibulum; CI, caudal infundibulum

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