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OF THE
24TH EUROPEAN CONGRESS OF VETERINARY DENTISTRY

European Veterinary Dental Society
2015
24th European Congress of Veterinary Dentistry
Ghent, Belgium | 4—7 June 2015

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Dear Colleagues

Welcome to the beautiful city of Ghent, one of the largest and richest cities of northern Europe. Most historians believe that the older name for Ghent — Ganda — is derived from the Celtic word ganda which means confluence. This is a tremendous and quite exciting fact that have an extraordinary meaning for us, because a congress is, above all, a confluence of peers coming from all over the world to share their knowledge, their research, their latest results. We are now presenting the 24th European Congress of Veterinary Dentistry, which means that this confluence has been happening for the last twenty-four years, almost a quarter of century. To note that in a city like Ghent is symbolic and wonderful.

Indeed, every year, the European Veterinary Dental Society (EVDS) has been able to provide an innovative and comprehensive overview of the latest research and standard of care developments in veterinary dentistry. At the same time, the European Congresses of Veterinary Dentistry have been aimed to provide basic streams to general practitioners, who attend each congress, and reach as much veterinary professionals as possible.

Many specialists and researchers will take part in this Congress, presenting from plenary sessions to posters. This year, one great novelty is that the best poster will be awarded with a prize.

Nothing of this could be materialized without the generous and committed support from the sponsors, the logistics and practicalities from the Local Organizing Committee, the scientific support from the European Veterinary Dental College and finally, but not least, the contribution from so many colleagues presenting their work or attending the event.

We really hope this 24th Congress could be once again an opportunity to increase knowledge, to exchange ideas, personal contacts and experiences. The EVDS also hopes that you can enjoy your stay in Ghent.

Yours sincerely,

Lisa A. Mestrinho
EVDS President
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Keynote lecture
The principles of techniques for cleaning root canals

Roeland De Moor

The aim of root canal treatment is the prevention and treatment of pulpal and periapical disease. In case of pulpitis, the treatment is aimed at preventing root canal infection by aseptically removing pulpal tissue and a dense filling of the entire root canal system providing a fluid tight seal. In case of apical periodontitis, the aim is to establish conditions favouring healing through elimination of the root canal infection and prevention of re-infection. In both instances, this implies CLEANING the root canal system (to remove organic tissue and/or bacteria), SHAPING it in order to receive a root canal FILLING that prevents both apical and coronal leakage. The most important stage in the disinfection of the pulp space is the chemomechanical preparation i.e. the combination of mechanical preparation and antibacterial irrigation. A variety of root canal instruments, root canal irrigants, irrigant activation devices and techniques have been developed. During this lecture the biologic principles of preparing root canals with emphasis on correct use of instrumentation techniques and systems are explained. The role and properties of contemporary root canal irrigants is also discussed.

Short CV: Prof. dr. Roeland De Moor is ordinary full professor at the Ghent University, where he teaches restorative dentistry, endodontics and dento-alveolar traumatology. He is the Director of the Dental Clinic of the Ghent University Hospital and former dean of the Dental School. He is also the head of the Department of Restorative Dentistry and Endodontology, and the responsible of the three-year Master after Master programme in Endodontics. His research is focussed on cleaning and disinfection of root canals a.o. laser activated irrigation and light activated nanoparticles, the use of lasers and light such as Laser Doppler Flow Metry and dental bleaching. His department has also an epidemiological research line focussing on endodontic quality, minimal invasive restorative techniques especially in root filled teeth, and the use of bioactive materials in endodontics. He gives lectures worldwide on the use of light and lasers in endodontics, on dental laser bleaching, and on the application of nanotechnology for endodontic purposes. He is (co)author of more than 150 international and national peer reviewed articles together with the Ghent Dental Photonics Research Clustre and BIOMAD (Biomedical Applications in Dentistry).
Presentations
Safety and ergonomics in veterinary dentistry

Katerina Slaba

ARVET veterinary clinic, Pisek

Risks during oral examination

Clinical oral examination on unsedated patient cares risks of bite injury due to the fact that it can not be performed with a muzzle. Proper and thorough oral clinical examination is possible only in sedation or anesthesia, when the risk of injury of examining surgeon and patient with examination tools (dental explorer, periodontal probe) is minimized. Even because of injury risks, dental procedures without anesthesia are considered unacceptable. Another risk during examination is the possible contamination of blood and saliva.

Risks during dental procedures

There are many potential risks for the veterinarian during dental surgery as results of working with hazardous substances (mercury, phosphoric, adhesives containing solvents such as toluene or xylene, disinfecting agents, agents used for developing radiographs, formaldehyde) and the risk of contamination with infectious aerosols (work with ultrasonic remover, high-speed handpiece). There might be even risks of allergic reactions (latex gloves). Inhalation anaesthesia gases pose a certain risks, too. Flying debris or drops of polishing paste can cause mechanical injury of the eye. Improper use of rotary instruments (eg. insufficiently secured diamond cutting disc) poses a significant risk of injury of the patient and the persons within the room when inadvertently released. Aerosol, blood, mucus, secretions of animals undergoing treatment represent biological risk - exposure is possible through open wounds, mucosas-ocular, nasal and oral mucosa.

UV light from the curing light designed poses a risk of damage to the retina.

Damage to the mucous membranes of the oral cavity of the patient by irritants can be avoided by using a rubber dam. Cofferdam is a special elastic membrane that is attached to the treated tooth, ensuring a dry working field and thus preventing contamination of the treated tooth and the environment (when using spray while rinsing) with saliva and blood.

Mercury enters the organism via skin or mucous membranes and inhalation into the respiratory tract. It is therefore recommendable to minimize use of amalgam (rather prefer amalgam capsules) or not use it at all. If mercury is used, it is necessary to use gloves and provide good ventilation of the room. Fortunately, amalgam as a filling material is used less and less in veterinary dentistry.
Phosphoric acid is used in dentistry in gel form for etching of the enamel and dentin, the concentration is usually around 40%. For its use threatening eye burns, skin, etc.. When not using the cofferdam it is preferable to rinse the gel while suctioning intensively or flush gel directly onto the compression pad so that it can not contaminate the oral cavity and irritate mucous membranes of the patient.

Latex allergy is relatively common in health care people.

Chemical risk when using anesthetic gases can be solved by gas evacuation system. In closed systems the most common source of contamination of the working environment are leaks from the circuit (under-inflated balloon of the endotracheal tube, leaks or cracks in the system, etc.). The system should be checked regularly. In case of pregnancy the possible risks should be consulted with the physician.

Biological (infectious) risk can be reduced by using protective equipment. Use of suction during surgery helps to limit these risks. Ventilation will help eliminate small aerosol particles. Rinsing oral cavity before surgery with chlorhexidine solution reduces the amount of contaminating bacteria; perfumed solution (e.g. CLSR) will also improve the working environment (partially eliminates odor). For some dental units chlorhexidine solution can be used (after switching the source of spray fluid) as spray. It is recommended to use chlorhexidine solution as a coolant in ultrasonic scaler. Production of infectious aerosols is a significant source of bacterial contamination of the environment, dental procedures should therefore be performed in separate rooms.

Noise from ultrasonic scalers (80 dB), high-speed handpiece (85 dB), suction, or compressor could damage hearing;

Risk of damage to the retina by UV light will be reduced, if one does not look directly into the light, but only through a color filter, which is usually part of the curing light. Color glasses can be also used.

The standards of personal hygiene

Hand washing and hand care

Wash your hands often during the working day - use warm water and gentle antibacterial soap. Hands should be maintained with manicured nails and trimmed cuticles. Rings and watches must be removed before washing. Injuries and abrasions should be covered with waterproof plasters. The site for hand washing should be easily accessible, ideally contactless. After work, use protective hand cream.

Wear protective equipment (masks, gloves, gowns, goggles, shields), don’t eat and drink.

Protective goggles, shield, face mask, cap

Protective goggles or protective shield attached to a headband can be used; glasses may also magnify or at least carry magnifying device. The disadvantage of these protective devices is that they can not completely prevent penetration of infectious agents from the air and also that may become fogged. This can be prevented by proper fitting of protective glasses and use of anti-fog solution. Face masks and surgical caps are other necessary equipment. Face masks should be tight. More effective than a face mask is a respirator. If a face mask is not fit enough, it can mist goggles up.

Gown

Clothing for treating dental patients should be reserved for this purpose only and should not be worn in other areas than those reserved for dentistry. Ideally, the dress should cover
the entire forearm and neck. Contaminated clothing should be washed in the washing machine using temperature at least 65° C.

**Gloves**

Change your gloves between patients. Gloves should fit on hand loose enough not to overload wrist at work. Universal gloves—same shape for right or left hand, can lead to excessive tension on the thumb while using, which can result in wrist tendonitis. Gloves should enable the palm to be free, it is best to use gloves designed for right and left hand. It is better to avoid gloves with powder as it sensitises, slows wound healing, powder in some gloves may slow or completely prevent polymerization of some dental materials. It is advisable to use gloves hypoallergenic or “low protein” to reduce the possibility of developing an allergy. The most common form is contact dermatitis, IV. type allergy with rash occurring 24-72 hours after irritation. Another common type is contact urticaria, which is an immediate reaction and manifests as urticaria, rhinitis, generalized pruritus and wheezing. Systemic reaction type is not frequent but can be very serious, causing asthma, conjunctivitis and systemic anaphylaxis. The reaction is worsened by the fact that the powder of latex gloves remains in the air long after gloves were put on.

**Noise**

Safe time exposure to noise above 90 dB is only two hours a day. One can work longer safely in the noise only while using hearing protection.

**Ergonomics**

Ergonomics is the science of the efficiency of man work in relation to his work environment. It includes all factors that affect the movements of the human body, its functions and responses to forces associated with specific tasks. Veterinary dentistry can be physically very demanding, often the dentist delicate and precise work occupies an awkward and uncomfortable position.

**Setting of the dental surgery**

Dental surgery should be arranged simply and clearly. Around the working space there should be adequate space for patient handling etc.. Storage space for work tools should be within the reach of the surgeon. The most important instruments (handpieces of the dental unit, ultrasound scaler...) should be closest, less frequently used (suction, curing light, dental materials and space for storing waste) should be within reach of an assistant. Setting of the workplace should ideally limit manual work, especially lifting and carrying the patient. Hand damage may be cumulative in nature and problems can occur even after a longer period of time.

**Ventilation and lighting**

Working area should be illuminated with light in the direction from behind the surgeon’s head; it is recommended to use dental head light. If the light is more than three times stronger than the background light, it is tiring for the eyes. Handpieces equipped with LED lights are preferrable. If necessary, use of an additional light source (optical cable) is possible.

Room for dental procedures as well as the darkroom should be well ventilated with fresh air. Ideal is slight underpressure, which ensures removal of air contaminated with bacteria.
**Working position**

Musculoskeletal pain as a result of poor positioning at work in veterinary dentistry is very frequent. The reasons are lack of space around the workplace, inadequate chairing, poor lighting, and inconvenient positions at work that lead to spinal pain (cervical, thoracic and lumbar) and shoulder pain. Repetitive strain leads to repetitive strain disorders.

By maintaining natural S-curve of the spine (using ergonomic seats for instance saddle shape), it is possible to avoid backache. On a standard chair we have to bend forwards to reach the work field before us, this imbalance is compensated by leaning on the elbows. This posture causes neck and arm pain and also hands are not free enough to work and work is not sufficiently precise. While working, the legs should be under body center of gravity. Table with adjustable height is preferred. There should be enough space for surgeon’s legs under the table, working end of the table should be accessible from all three sides.
It is well known that periodontal disease is the most commonly encountered disease in small animal practice. It should therefore also be the most commonly treated disease in small animal practice. In order to provide treatment early in the disease course or preferably, instigate a preventative approach to periodontal disease, the veterinarian needs to convince the client that their pet has a problem. It is anecdotally reported by veterinarians that they tell the client every year that their pet requires a ‘dental’, and yet they never present their pet for treatment. Ultimately, the pet finally receives treatment at a very late stage in the disease process. There may be many contributory factors to this, and yet the veterinary surgeon is unlikely to blame themselves for this failing in animal care. However, the way a recommendation is made can influence the outcome. Telling the client that the pet’s teeth are ‘dirty’ and it ‘probably needs a dental within 6-12 months’ is unlikely to persuade the client to intervene. This talk will examine the reasons for poor client compliance, and provide the veterinary professional with tips on how to make an adequate recommendation ensuring their patients receive the correct treatment at an early stage of the disease process.
With the advanced version of the electronic Veterinary Dental Scoring programme (e-VDS plus) the EVDS has fulfilled their trilogy of tools bringing dentistry to the people. While the basic version is a tool which is mainly aimed to support the general practitioner in his daily work, the advanced programme provides a wide variety of scoring options for more advanced veterinarians.

The results are scored with mouse clicks on dental charts (created and with the kind permission of David Crossley) for dogs and cats, for primary and permanent dentition. Clinical findings are scored in coloured marginal markings, while treatments and missing teeth in coloured full markings of the tooth. Currently there are only English, German and French available as screen language.

Trying to be not at all excessive some adaptions have been created: for dogs the classification of tooth fractures is very detailed (but only one term for tooth resorption), whereas for cats tooth resorptions are very detailed (but only one term for fracture).

A lot of attention has been paid to all inflammatory findings. The classification of periodontal disease, mobility and furation can be scored in detail according to the official staging published by the AVDC, whereas gingival recession and enlargement can be scored in millimetres. The periodontal probing depth is measured at four points (mesial, buccal, distal, lingual/palatinal) and can be scored in four figures which provides quite a good impression of the situation.

Calculus is scored as an overall scoring. There is space for description of oral masses. Normocclusion and malocclusion class 1-3 can be selected with mouse click. The selection of terms for ‘orthodontics’ provides good options to define the situation of a class 1 malocclusion more precisely.

A new feature is the option to upload x-rays and photographs. At this stage the images cannot be implemented in the printout.

The assessment can be downloaded and saved as PDF. A printout of the scorings with your clinic data and logo is thought to be handed out to the pet owner. For this reason the terms on the printouts (available in E, F, D, I, E, PT but easily adaptable to any language) are in everybody’s language. For paper work and for residents there is an option of an ‘Academic Printout’ with all official terms according to the Committee of Nomenclature of the AVDC.

There is a possibility to perform a basic evaluation for statistical purposes with the option to select one issue within a selected period of time.
For more convenience in daily work, e-VDS can be integrated in Practice Management Software (PMS) that use the e-VDS web service. This system avoids the need to enter data twice. PMS sends owner and animal data to e-VDS software directly, as commonly occurs for digital x-rays (more information: http://www.evds.org).

The e-VDS basic is free for everyone, the e-VDS plus is free for EVDS members. Other users have to pay a mild yearly fee. The e-VDS plus is free for use for all users to try out until the end of July 2015.

Fig. 1: Screenshot of the scoring programme (draft version)

Fig. 2: Printout of the e-VDS plus scoring (draft version)
Dental radiograph units

Radiographic exposure is controlled by 3 components: kVp (kilovolt peak), MA (milliamperage), and exposure time. KVP controls the “quality” of the x-ray beam. This is the power of each particular x-ray particle which controls the penetration of the beam through tissues.

The quantity of the exposure is controlled by MA and time of exposure. The higher the MA, the more x-rays produced over the time period. Multiply this number by the exposure time and you will get the total number of x-ray units.

Since there is not a significant amount of variation of tissues in oral radiology, the KVP and MA are set constant on dental radiology units. The only variable factor is time. This is measured in seconds or pulses. One pulse is equal to 1/60 of a second. Most standard (human) dental radiology units have a digital control for the exposure and it is set by the operator based on a technique chart. Recently, however, veterinary specific machines have become available which has a computer that sets the exposure based on the size of the patient, the speed of dental film used, and the particular object tooth. This can take a lot of the guesswork out of the exposure setting. However, with a little experience and practice, it is easy to figure out a setting.

Dental radiographic film

Dental film is non-screen film. This means that it is directly exposed by the x-ray and does not require an intensifying screen. This gives much more detail than standard radiographic film, but requires a higher amount of exposure. It is packaged in its own paper or plastic sleeve, to protect it from light and the oral environment.

There are two types of dental film commonly used in dental radiology. These are Ultra-speed “D” and Ektaspeed “E” film. Recently “F” speed film has become popular. The difference is in the size of the silver halide crystals and secondary to this the amount of exposure required to expose the dental film. “E” speed film requires approximately ½ the amount of radiation for exposure than “D” speed film, and “F” speed even less. This decreases exposure to the patient and staff as well as decreases the wear and tear on the x-ray unit. There is a slight decrease in resolution with faster films due to the larger crystal size, but according to most experts, the difference is negligible. Therefore, it is recommended...
in human dentistry to use “E or F” speed to decrease exposure time. They are more technique sensitive, however, in both the exposure and development of the image. This may be frustrating for the novice, therefore it is generally recommended that practitioners start with “D” speed and advance to “E or F” speed when they are more comfortable with the settings and positioning.

There are several different sizes of dental film available (4, 3, 2, 1, and 0). The most common sizes used in veterinary medicine are 4, 2, and 1. Size 3 are bite wings and are generally not used in veterinary medicine. Size 4 (occlusal) film is the largest available, it is used mostly in large breed dogs or when taking whole mouth radiographs. For small dogs and cats and most any single tooth radiograph, size 2 (standard) is commonly used. For the mandibular first and second premolars, and very small cats and puppies size 1 (or 0) (periapical) are used.

Another consideration in selecting film size is cost. Size 4 film is about 3 times the cost of size 2. Therefore, if you can use a size 2, it is recommended. However, it is much easier to position size 4 films, allowing for much more latitude in positioning. This will result in less retakes. Therefore, the less experienced may consider practicing with size 4 film and graduating to size 2 when a level of skill is obtained.

**Digital Dental Radiology**

There are numerous human veterinary digital systems. These are excellent means of obtaining dental radiographs. The only major problem currently is the lack of a number 4 sensor. The major advantages to these systems are the decrease in radiation exposure, rapidity of the development, and that you can reposition the sensor if the view is not correct the first time. There is one company, however which makes a size 4 phosphor plate (CR).

**Taking a dental radiograph**

*Step 1: Patient positioning*

Position the patient so that the area of interest is convenient to the radiographic beam. In general this is where the object is “up”. For maxillary teeth, the patient should be in ventral recumbency. For mandibular canines and incisors the pet should be in dorsal recumbency. Finally, for maxillary cheek teeth, the patient should be in lateral recumbency with the affected side up. This being said, in our practice virtually all radiographs are exposed in lateral recumbancy. This takes some getting used to, but decreases the number of times a patient must be rolled when doing surgical or endodontic procedures.

*Step 2: Film placement within the patient’s mouth*

There is an embossed dot on the film. The convex side of this should be placed towards the x-ray beam. In most films, this side is pure white. The opposite or “back” side of the film will usually be colored (purple or green). Place the film in the mouth so that the entire tooth (crown and entire root surface) is covered by the radiograph. Remember, the roots of all teeth are very long. This is especially true of canine teeth, which are longer than you think. Always err on the side of having the film too far in the mouth to ensure you do not cut off the root apexes. The film should be placed as near as possible to the object (generally touching the tooth and gingiva) to minimize distortion.

*Step 3: Positioning the beam head*

There are two major techniques for positioning the beam head in veterinary patients. Both of these techniques are used daily in veterinary practice.
Parallel technique: This is where the film is placed parallel to the object being radio-graphed and perpendicular to the beam. This is how standard (large) films are taken. This gives the most accurate image. Unfortunately this is only useful in the lower cheek teeth in the dog and cat. This is due to the fact that these patients don’t have an arched palate. The film cannot be placed parallel to the tooth roots because of the palate’s interference. Therefore this technique is not always possible.

Bisecting Angle Technique: This is the most common type of dental radiograph taken in veterinary patients. This uses the theory of equilateral triangles to create an image that accurately represents the tooth in question. To utilize this technique, the film is placed as parallel as possible to the tooth root. Then the angle between the tooth root and film is measured. This angle is cut in half (bisected) and the beam placed perpendicular to this angle. This gives the most accurate representation of the root.

If this angle is incorrect, the radiographic image will be distorted. This is because the x-ray beam will create an image that is longer or shorter than the object imaged. The best way to visualize this is to think of a building and the sun. The building will create a 90 degree (right) angle to the ground. The bisecting angle in this case is 45 degrees to the ground.

Early and late in the day, the sun is at an acute angle to the building and casts a long shadow. In radiology this occurs when the angle of the beam to the object is too small and is known as elongation. At some point in the late morning and early afternoon, the sun is at a 45 degree angle to the building, which is the bisecting angle. This gives an accurate representation of the building height. As the sun continues up in the sky, the shadow shortens. This occurs in veterinary radiology when the angle is too great and is known as foreshortening. Finally, at noon, the sun is straight up from the building, which gives no shadow.

The “Simplified Technique” as developed by Dr. Tony Woodward does not utilize direct measurement of any angle, instead relying on approximate angles to create diagnostic images. There are only 3 angles used for all radiographs in this system 20, 45, and 90.

Mandibular premolars and molars are exposed at a 90 degree angle, maxillary premolars and molars at a 45-degree angle, and incisors and canines at a 20 degree angle.

To initiate any radiograph, place the film in the mouth and set the positioning indication device (PID) perpendicular to the film. For mandibular cheek teeth, this is the correct placement. For the maxillary premolars and molars, rotate the beam to a 45 degree angle. For the incisors and mandibular canines rotate 20 degrees. For the maxillary canines an additional rotation 20 degrees lateral is necessary to avoid superimposition of the first and second premolars.

Step 4: Setting the exposure

If you are using a machine where you set the exposure manually, you will need to set up a technique chart similar to one for a standard (large) unit. The good news is that there is only one variable that needs to be adjusted.

If you are utilizing the computer controlled system, set the buttons for the species, size of the patient, and tooth to be imaged. If you have correctly set the machine and the image is incorrectly exposed, the easiest way to adjust is to change the f setting. By pressing this button, you will see the numbers go up on both sides. The one on the left is the f number and the one on the right is the exposure time. If you continue to press the button it will continue to increase the exposure until you reach 9 when it will markedly lower and the f number will go back to 1. If the radiograph is overexposed (too dark) lower the f number by 1. If it is underexposed (too light) increase the number by 1. Continue this process until you have the film that you want. Generally, the f number will be the same for all radio-
graphs once you have discovered the correct setting for your machine start at that number in future sessions.

**Step 5: Exposing the radiograph**

Dental radiograph machines have a hand held switch to expose the radiograph. If it is possible, leave the room prior to exposing the radiograph. If it is not, stand at least 6 feet away at a 90 to 130 degree angle to the primary beam (meaning to the side or back of the tube head, not in front or behind). Once everything is set, press the button. It is important to remember, that these switches are “dead man’s”. This means if you let up during the exposure, it will stop the production of x-ray beams. On a standard unit, this will make a light radiograph, on a computer controlled one it will give an error message and you will need to start over. Make sure you hold the button down until the machine stops beeping.

**Step 6: Developing the radiograph**

The most economical way to develop the radiograph is coffee cups filled with dental developing solutions in your darkroom. (Using chemicals other than products for dental radiology will result in inferior film quality) Although developing films in a darkroom can produce quality films, the use of a chair side developer has several distinct advantages.

1. The chair side developer also allows you to easily judge when development time is correct, and be able to evaluate your films in only 1-2 minutes.
2. The technician does not leave the room and can still monitor the patient.
3. The units take up very little space, minimize chemistry use, clean up easily and store quickly.

To develop films, begin by peeling back the covering layers from the film, taking care to handle the film only by the edges. Use a film clip to grasp the corner of the film and place it in the developer. When developing a size 4 film, make sure to immerse the entire film in the liquid to ensure that the whole film gets developed. Develop the film until an image is just visible (sight developing). Then rinse the film briefly in a water bath, and place the film in the fixer for one minute until partially fixed. The film may be evaluated at this time, but should be placed back in the fixer for an additional 10 minutes to ensure complete fixation (archival quality). When completely fixed, the film becomes clear and will lose all traces of a greenish color. The film should then be thoroughly rinsed in running water or placed in a clean water bath for 10-15 minutes. This is followed by a final rinse to remove all traces of fixer. Be sure to remove the clip and rinse all film surfaces thoroughly. Traces of fixer remaining on a dental film give it a characteristic “slick” feel, therefore rinse the film under running water while gently rubbing the film between your fingers, for a few seconds, until the film does not feel slick. The film is then placed in drying clips overnight to dry. Make sure to dry the film completely to ensure that they do not stick together.

Be sure to change the solutions whenever the developing and fixation times seem to be slowing down. This will occur after you have developed and fixed around 20 smaller (#0 or #2) films, or 10-15 larger (#4) films. Use of exhausted chemistry results in poor image quality and hazy images.
Feline stomatitis represents always a therapeutic challenge. As such, the pathogenesis must be well explained to the owner in order to obtain its support during the various stages of the treatment.

The treatment plan is now well recognized but too often the search for a ‘miracle’ solution both to oversimplification the therapeutic approach.

Most of the time Feline stomatitis are appreciated evenly by habit or lack of information. The etiology of this condition remains unclear, the clinician must strengthen the rigor of clinical examination: better define lesions allows to better compare more accurately their fate and qualify therapeutic needs that if relevant.

If extensive dental extractions have become the usual therapy, it is essential to understand the foundations of this approach.

Definitions

**Bucco stomatitis:** inflammatory lesions of the mucous membranes overlying the cheek, lips and the oral vestibule.

**Alveolar stomatitis:** inflammatory lesions of the mucous membrane covering the dental alveolus.

**Caudal stomatitis:** inflammatory lesions of the mucous territories covering the space between the pillars of the pharynx medially, pharyngeal ditches caudally, and tonsillar lodges laterally.

**Glossitis:** inflammatory lesions of the mucous membrane covering the base of the tongue.

**Periodontitis:** inflammatory lesions of the gingiva and periodontal apparatus. These are not strictly speaking parts of “Stomatitis” but regularly associated clinically in an exceptionally “aggressive” development or their more usual ‘chronic’ form.

The described lesions are associated or not with each: “caudal stomatitis” +/- “bucco stomatitis” +/- “aggressive or chronic periodontitis.

The prevalence of feline stomatitis is variable depending on the population studied: 2.6% (Crossley 1991); 12% (Verhaert 2004); 5.5% (Girard 2008). A study on 4800 cats, 3 months of study, derived from ‘General practice’, reveals a prevalence of 0.7% and a rate of new annual recruitment by vet by 50%. (Healey 2007)
Etiologies

A disimmune syndrome of unclear origin

The oral mucosa against pathogenic agents is protected by a set consisting of a physical protection (cell desquamation, saliva, enzymes) and more specific factors (vasodilatation, plasma protein, complement). The chronicity of the infection is characterized by progression of inflammatory cells from the plasma line: macrophages, monocytes. They infiltrate tissues more in depth. The opsonization (C3b, Ac) of bacteria increases their efficiency, and increases also by the same release of bacterial degradation products.

The activation of the mucosal immune system and the specific immune system occurs both at the level of the gingival fluid and at the level of saliva. The inflammatory process does not progress continuously. Following the interrelationship of all these agents, it can settle a State of balance itself interspersed with various phases of resurgence.

The pathogenic mechanisms involved are therefore excessively complex and varied: direct incidence of bacteria in dental plaque (lyopolysaccarides, proteases, leucotoxines...), impact of the consequences of inflammatory response related to the bacterial presence (super ions oxides, collagenase...), incidence of various immune reactions (cytokines, factor tumor alpha...).

The observation of ulcerative or proliferative inflammatory lesions, presenting a slow destruction of periodontal tissue is synonymous with a form called ‘chronic’ supported by the human population canine and feline and that all degrees of varying intensity. Inflammatory lesions associated with acute and intense evolution are the expression of a so-called “aggressive” form that occurs in a low proportion in the dog and cat.

Feline stomatitis is destructive local chronic inflammation affecting the mucosa and sub Mu-

In the presence of aggressive inflammation next to the dental arches, the initiator role of the inflammatory cascade is attributed to dental plaque.

In the presence of a caudal inflammation, no study allows to specify clearly aetiological agents, even if originally there still the local immune system of the individual lies to be overhang.

Impact of the Calicivirus

Two conflicting results studies have analyzed the pathogenic role of the Calicivirus. (Knowles 1991 - 1992 Reubel) It describes the development of a form of acute and transient caudal stomatitis in Spf cats infected with Virus FCV strain from cats that have developed a chronic stomatitis. No proven link is for now clearly established with the development of the entity ‘caudal chronic stomatitis.

Recent studies underscore the importance of a possible more descriptive clinical examination for progress in etiological analysis of feline stomatitis. Few published studies use a terminology appropriate to evaluate properly such type of medicine, such type of further examination or such viral prevalence. The coming years we will make probably more accurate information on the incidence of certain virus (FCV, HV1, FIV, FeLV), and improved (immuno-histology) histo-pathological knowledge of this condition.

Therapeutic strategy

Feline stomatitis always represent a therapeutic challenge. Such illness must be well explained to the owner in order to obtain its support during the various stages of the treatment.
The treatment goal is twofold:

• Drastically reduce the dental plaque by teeth surfaces control.
• Control inflammation of periodontal tissue and associated osteitis.

Dental extractions in number appear the only way to permanently ensure the removal of dental plaque, considering that the intensity of the pain does not allow a familiar control of dental plaque by conventional measures of oral hygiene.

Professional dental examination and treatments appear essential as oral inflammations present are most of the time intense and long standing, and associated with severe and or acute alveolar osteitis.

Dental extractions in number permit control of the pain issue from oral mucosa stimulation by plaque and the pain issue from dental disease themselves.

Decision-making criteria of tooth extractions: what are teeth to be extracted?

1. Caudal stomatitis: extraction of premolars, molars and incisors at minima +/- canines (depending on alveolar inflammation observed at the radiologic exam).
2. Aggressive periodontitis (loss of attachment periodontal > 20%)
3. Chronic periodontitis: loss of attachment periodontal > 50%
4. Tooth resorption: any stage of development.
5. Bucco stomatitis: conservative care and/or surgical care on the basis of dental lesions.

Dental extractions in number are the only response efficient and realistic way of ensuring a satisfactory therapeutic response.

Great attention must be given to the atraumatic characteristic of the surgery. We try here to reduce the total tooth surface supporting plaque in combination to the control of facial pain issue of periodontal tissue and or associated osteitis. It is therefore not question here to simply break the teeth of a cat without worries of the fate of the residual root fragments. It is always necessary to perform curettage of the alveolar lodges, alveoplastie, displacement of a gingival mucosal flap enveloped cover alveoli sites and enhance the chances of a non-chronic inflammatory healing period.

In experienced hands surgical treatment is a long and delicate process which requires an anesthetic time of 90 minutes. This procedure shows however results always very encouraging: 60 cats suffering from “caudal stomatitis” and treated with oral surgery - 87% have a clinical improvement and 50% medical healing after a follow-up of 6 months post procedure (WVDC 2006).

Treatment plan

1. Medical treatment (pre operative)
2. Surgical treatment
3. Short-term post operative medical treatment
4. Mid-term post operative medical treatment
5. Long term medical treatment
Post-operative Medical assessment

Clinical examination of the operated animal must be always be faced with the initial operating pre review. The conduct of the examination is often delicate both pain live little persist. Despite all attention must be paid to observe the lesion minimum in order to guide the diagnosis. The oral cavity lesions are defined according to a specific nomenclature. The criteria for pain are recorded following the same standards.

Review clinic vigil

Bearing in mind the treatment plan, the practitioner proposes a timetable of accurate tracking for continuous therapeutic management in general to the owner. This solution is a particular financial approval but requires a prior informed consent.

The memorials are here too if this is more important than the medical examination itself says.

Short-term post operative medical treatment (1 month)

- Deprivation of anti-inflammatory steroid.
- Anti-inflammatory drugs - antibiotic: how often? : in the short term, the objective is the control of pain. Analgesics are the cornerstone of the medical treatment. They are used in oral or parenteral form in post operative: note for e.g. buprenorphine, tramadol, but we prefer generally NSAIDs. An antibiotic is systemically associated: oral tetracycline, clindamycin, metronidazole, usual doses.

Mid-term post operative medical treatment (1-6 months)

- Well to objectify the improvement of clinical outcomes: a study recent (Girard Hen-net) presents the results of surgical treatment of 60 cats “Caudal stomatitis” after a 6-month follow-up:
  - 87% 6 months clinical improvement (decrease in the threshold of medicalization)
  - 50% healing at 6 months (cessation of medical treatment).

This study again shows a lack of positive correlation between the level of medicalization operating pre and the clinical outcome. This both demonstrate that the surgical therapeutic prognosis can be favourable or unfavourable prejudice following medical history. NSAIDs, antibiotic,...check the adherence to treatment (analgesics are often used by the parenteral route in cure and sometimes combining NSAIDs + opioid effects).

- AC poly unsaturated fats
- Oral bandage
- Chlorhexidine oral gel: effective support in the control of oral bacterial infections, but difficult compliance (palatability).

Long term medical treatment (6-12 months)

1. What interest for time factor?

- Regularly disregarded, and yet (so) important.
- Therapeutic target at 6 months post op = 10% of cats
- No existence of “long term” study (> 6 months)
- Treatment compliance
Long-term medical treatment is dedicated to patients presenting no improvement and still supporting a high pain threshold = absence of “clinical healing”.

2. What interest for cyclosporine? (Lommer 2013)

- Prescription in post operative; Treatment after 1 month of care post op in the presence of pain or injury. Not concomitant cortisone
- Short study on 6 weeks; Small population: 16 cats.
- 73% Improvement clinic vs. 12% for placebo
- $[\text{cyclosporine blood}] > 300 \text{ ng/ml}$ 72% improvement
- $[\text{cyclosporine blood}] < 300 \text{ ng/ml}$ 28% improvement
- $2.5\text{ mg/kg - 2 / J}$
- “Interest of the molecule”: inhibiting calcineurin, reduction in IL-2 expression... and regulation LT.
- Interest of the study: low number of cats (16) - low duration of the study (1.5 months) - homogeneity of clinical cases? - Eviction of the time factor.

3. What interest for cortisone?

The long term they are used as a last resort treatment and oral form. The ultimate goal of medical monitoring remains the complete withdrawal of any form of corticosteroid therapy. In the end they are walls introduced in the medical arsenal, because despite all obvious therapeutic effectiveness: decrease of pain through better control of inflammation, can high orexigenic.

- Avoid the circle vicious efficacy-dose-interval...
- Decrease neutrophil diapedesis
- Redistribution lymphocytes in the vascular extra compartment
- Decrease in regulating maturation macrophages
- PuPd - diabetes - asthenia

4. What interest for replicated feline omega interferon?

The therapeutic qualities are anti-viral and immune-modulator agent. Among the different proposed therapeutic modalities (intra lesionnal injections, oral prescription, subcutaneous injections), only forms subcutaneous and oral treatment were evaluated.

This is a Type 1 Interferon that has antiviral activity marked especially against FCV, Coronavirus, HV1. The recombinant form genetically prevents production of antibodies to Interferon and interferon of human origin unlike.

The mode of oro-pharyngeal therapeutic action is considered be due an immunomodulatory through pharyngeal lymphoid tissue action and paracrine activity after destruction in the digestive tract; This effect is a priori dependent dose. (Regulation is known as paracrine when it involves the signals exchanged by neighbouring cells).

Study of the effectiveness of InfFel Omega replicated oral on a population of 39 cats: duration of the study 3 months; comparison with Prednisolone oral.

Results show a reduction in clinical lesions scores and scores of pain for the ReInF omega group but even if no statistical difference comes confirm this observation except for the values of J60 and J90. pain(Hennet 2011) Interferon replicated gamma feline has therapeutic qualities as an anti-viral and immunomodulatory agent. The different therapeutic modalities proposed are not yet validated by statistical studies.
**Protocol Fe-Inf-Omega: oral, 100,000 U daily**

1. Dilute 10 MU in 1 ml solvent.
2. Separating the Volume three in three distinct from 1 ml syringes.
3. Dilute 1 syringe in 15 ml NaCl (20 ml syringe).
4. Freeze the other two 1 ml syringes.
5. To swallow 0.5 ml per day: 100 000 U Fe - Inf - Omega daily.
6. Treatment for 3 month.

Interest of this protocol studied: low number of cat (39) - low duration of the study (3 months) - homogeneity of the case? -Eviction of the time factor.

**Conclusion**

It is clear that few published studies demonstrate the effectiveness of such type of medicine or such type of complementary examination. Hope that the coming years bring us more accurate information via improved fundamental knowledge about the peculiarities of this feline disease (virology, immunology, immuno-histology).
Tooth fractures are a cause of oral discomfort and decreased appetite in dogs and cats. They are commonly seen in general practice with a reported prevalence in dogs of up to 25 to 27% or higher when associated with other maxillofacial injuries. Functionally important teeth appear to be the most commonly affected. Affected patients can also show more than one fractured tooth per any given anesthetic episode and/or presented repeatedly for fractured teeth.

Tooth fractures can occur as a result of trauma or they can be secondary to dental conditions that affect the structural integrity of the tooth such as root replacement resorption, carious lesions, congenital enamel or dentinal dysplasia, and/or attrition/abrasion. Fractures are categorized depending on the extent of the resulting defect. Complicated fractures lead to direct pulp exposure whereas uncomplicated fractures can lead to indirect pulp exposure (i.e., dentinal exposure). Fractures can involve the crown, the root, or both areas of a tooth, with vertical root fractures being the most difficult to diagnosis.

The pulp-dentin complex is an exquisitely sensitive structure. Convergence of pulpal afferents with afferents from other oral structures in the central nervous system makes pain localization very difficult. Dentinal sensitivity can be explained by three different mechanisms: the presence of nerve endings in dentinal tubules, odontoblasts serving as receptors, and fluid movement along the dentinal tubules which can be registered by free nerve endings in the pulp. This sensitivity is thought to play a major role in a complex vascular, nervous and immune interplay responsible for maintaining pulp homeostasis.

The first reaction to an injury that results in pulp exposure is hemorrhage and pulpitis. Pulpitis, or inflammation of the dental pulp tissue, occurs in response to an insult. Dentin is also a vital tissue and as such can undergo a reparative process after receiving a stimulus. The response of both tissues will vary depending on the extent and duration of the injury/stimulus, and the age of the animal. A slow onset, chronic insult (i.e., tooth wear) will lead to occlusion of dentinal tubules through collagen or mineral deposition. Odontoblasts will also attempt to protect the pulp tissue by laying down tertiary or reparative dentin which contains less collagen and is enriched in non-collagenous matrix proteins.

On the other hand, if the insult is rapid and severe, the odontoblasts may not survive the trauma and at that point the injured pulp needs to react. In these situations perivascular undifferentiated mesenchymal cells or subodontoblastic mesenchymal cells will differentiate and produce reparative dentin. If the pulp tissue remains enclosed, increased inflammatory cell numbers in the pulp canal and hemorrhage may lead to irreversible
pulpitis by strangulation of the pulp tissue.

Root fractures can heal favorably in those cases were the coronal fragment is stable, the tooth is immature, and with rapid treatment (i.e., close reduction and semi-rigid splinting). These fractures can heal with calcified tissues, connective tissue, or a combination of both. Inflammatory tissue between fracture fragments without healing can be evident on intraoral radiographs as a widening of the fracture line with rounding of the edges and/or a developing radiolucency.

Despite lack of pulp exposure, intraoral radiographs of fractured teeth are recommended in order to rule endodontic disease which can even result from concussive trauma alone. In fact the current recommendation by the International Association of Dental Traumatology is to take at least 4 different views of any injured tooth. In the event a soft tissue laceration occurs at the same level or near a tooth fracture, radiographs of the area should be taken prior to closure of the lacerations in order to rule out embedded foreign bodies on the site that may prevent healing. Radiographs of fracture teeth should evaluate: root canal width, apical closure, proximity of fractures to the pulp, fracture height in relation to the alveolar margin, as well as, concurrent endodontic/periodontal disease, tooth resorption, or bony fractures.

If there is no pulp exposure conservative management via odontoplasty and sealing of exposed dentinal tubules can be performed. Current research states that if dentinal thickness is below 0.5mm a protective layer of hard setting calcium hydroxide should be placed prior to final tooth restoration in order to protect the pulp tissue. Once pulp exposure occurs, extraction or endodontic therapy is recommended. Despite the treatment approach selected, it is imperative for it to be performed in a timely manner. This will prevent entry of bacteria into the pulp canal and extension of the infection into the periapical tissues and also alleviate patient discomfort. Crown root fractures may require periodontal treatment before endodontic treatment is completed.

The type of endodontic therapy performed for complicated fractures is largely dependent of the age of the patient and the duration of pulp exposure. The initial inflammatory response can extend by 2 mm into the pulp tissue; however, as bacteria become involved, slow apical migration of the inflammation will occur. Although complete pulpectomy may carry a more predictable treatment outcome, partial pulpectomy and pulp capping should be attempted whenever possible in order to maintain a vital tooth and allow for continued root development and dentinal deposition. In a controlled, sterile environment were pulp exposure is induced, vital pulp therapy can have up to 100% success rate. Root canal therapy in veterinary medicine has shown to have up to 94% success rate however, the definition of success for this therapy has not been clearly elucidated.

Extraction of fractured teeth can also be considered in cases were a non-functional tooth has been affected or in those were financial limitations or contraindications for multiple anesthetic episodes exist. In cases or crown root or root involvement open extractions are indicated and post-extraction radiographs should be performed in order to confirm complete removal of all tooth structures.

Close monitoring of endodontically treated teeth and those with uncomplicated fractures is recommended. Radiographic monitoring should assess for signs or apical or periradicular periodontitis, arrest or root development, internal or external resorption and/or stenosis or obliteration of the pulp canal.

This lecture will discuss indications, contraindications, step by step methods, and follow up recommendations for each technique. The current literature on each method will also be reviewed.
When one considers the long, drawn out, chronic nature of periodontal disease, with waxing and waning periods of inflammation and tissue destruction, they will not likely view such a process as one requiring treatment on an emergency basis. When considering oral disease in this context, it may be difficult to imagine how the terms oral, dental, and emergency would actually fit together. Yet further reflection reveals any number of dental and oral situations that should, in all rights, be treated as emergencies.

Describing these emergencies in a time frame with which they should be addressed may help to further define the nature of the emergency, and triage it for treatment. Likewise, describing these emergencies by how they threaten the vitality of the patient versus the vitality of the dentition also may help to define the nature of the emergency. Therefore, for the purposes of this discussion, emergencies will be described on a tiered basis. The first tier covers those emergencies requiring attention within seconds to minutes in order to stabilize a critical patient. The second tier covers the emergencies that require attention in one to three hours to preserve function of the dentition or to prevent deterioration of the patient to a first tier condition. The third tier addresses emergencies that require attention in 12-24 hours to minimize patient morbidity. And finally, the fourth tier encompasses emergencies that require attention in 1-2 days for ideal case outcome. Obviously, there will be overlap between tiers, and rigid rules on paper are no substitute for clinical judgment and the ability to assess overall patient stability before proceeding with general anesthesia.

The first level emergencies include two life threatening situations: acute hemorrhage from major vessels, and airway obstruction. The vasculature to the face and oral cavity is extensive. Initial vascular branches off the external carotid arteries serve the mandibles and associated tissue in the form of the lingual and facial arteries. The external carotids progress and transform to the maxillary arteries, which then supply additional vasculature to the mandibles in the form of the inferior alveolar (mandibular) arteries. Progressing to the maxillae, terminal branches off the maxillary arteries become the infraorbital, sphenopalatine, and major palatine arteries. Laceration secondary to bites and vehicular trauma, blunt trauma, or iatrogenic transaction of any of these major vessels can result in extensive and even life threatening hemorrhage. Obtaining hemostasis and supplying volume support to these cases is critical for patient stabilization. Volume support with crystalloids, colloids, or blood products will be required. In some cases, in addition to oronasal compressive packing and use of topical hemostatic agents, cold packing the...
The site of tissue injury may create the vasoconstriction necessary to help control hemorrhage. Sedating a hyper-excitable patient may also help to control spikes in blood pressure that interfere with clot stabilization. Ultimately, a decision must be made whether or not to surgically ligate a lacerated vessel. Some transected vessels can be isolated, while others may prove to be impossible to access, causing one to consider the option of ligating the external carotid artery on the affected side.

Airway obstruction is another first tier emergency requiring immediate attention. While veterinary patients may present with any variety of foreign bodies lodged in the back of the throat or trachea, oral masses may produce the same effect, depending on their location and degree of mobility. Likewise, soft tissue swelling in the oropharynx secondary to trauma or inflammation can also result in eventual airway occlusion. Severe tonsilar enlargement or laryngeal paralysis may also precipitate acute airway obstruction. Although removal of a foreign body may halt the crisis, some patients may require intubation or even a tracheostomy to effectively manage the emergency situation.

Trauma resulting in tooth avulsion is an emergency from the standpoint of saving the tooth and preserving function. Obviously head trauma per se may produce far more life threatening circumstances that demand critical care support. However, in a stable patient, an avulsed tooth should be managed in the 1-3 hour (second tier) time frame. Avulsed teeth are ideally transported in osmotically balanced solutions such as HBSS (Hank’s Balanced Salt Solution), but can be safely suspended in milk or physiologic saline as well. Water is the least desirable transport media due to its hypotonic nature and potential to cause cell lysis. Preservation of vitality of the periodontal cells is critical for successful periodontal healing. Transport media such as milk may preserve periodontal ligament cell viability for 3 hours, and HBSS offers even greater time allowances. The time frame for successful replantation of an avulsed tooth decreases dramatically if the tooth is allowed to dry outside of the mouth. In people, if extraoral dry time is under 20 minutes, the tooth stands an excellent chance to undergo periodontal healing. If the extraoral dry time exceeds one hour, all the periodontal ligament cells have died, and complications with root resorption are high.

Prior to replantation, the avulsed tooth is gently rinsed (not brushed or scrubbed) with physiologic saline to remove contaminants and foreign debris. The root surface must be handled as gently as possible to avoid causing additional trauma to the periodontal ligament cells. Intraoral dental radiographs should be taken to assess the integrity of the alveolus prior to replantation. It too is gently rinsed and cleared of debris, clots, and obsta-
icles prior to replacing the avulsed tooth. Once the tooth is replanted, the mouth should be evaluated for proper occlusion. If satisfactory, the tooth is acid etched and splinted in place with a combination of interdental wiring and dental acrylic to achieve semi-rigid fixation. If there is no accompanying damage to the alveolus, the splint is maintained for 7-10 days. If there is alveolar damage, the splint is maintained in place for 4-8 weeks. The patient is treated with appropriate pain management and antibiotic prophylaxis.

Pulp necrosis will occur with avulsed adult teeth, even if they are replanted in a timely fashion and properly splinted. Mature teeth with closed apices will require endodontic therapy to maintain long term function of the tooth. Immature teeth with open apices may have a chance at revascularization, and continued root development may be possible, and may benefit from topical minocycline or doxycycline treatment during replantation. If the immature tooth fails to maintain viability, apexification and eventual root canal therapy will be required to maintain the tooth.

Dental emergencies falling into the third tier of classification (address in 12-24 hours) are those such as maxillary and mandibular fractures, and temporomandibular joint luxations, especially in the cat. Again, head trauma per se may produce far more life threatening circumstances that demand critical care support before the patient can be safely anesthetized and managed for facial fractures. The goal is to rapidly return the patient to function, allowing it to eat and drink on its own. This is especially a concern with feline patients, who may often require the placement of a feeding tube to ensure proper nutrition delivery during their convalescence. In the case of temporomandibular joint luxations, reducing the luxation before a blood clot firmly seats and fibroses may assist in proper seating of the condyloid process into the mandibular fossa. The typical case scenario is a traumatized cat presenting with a dropped lower jaw and unable to close its mouth. The mandibular canine tooth opposite the side of the luxated TMJ appears to occlude laterally to its normal position against the maxilla. Additionally, rostrodorsal luxations in the cat may also involve fractures of the mandibular condyle and articular eminence (human terminology), leading to an inherently unstable TMJ, despite the reduction. These cases may require additional stabilization, such as bonding the mandibular and maxillary canine teeth together with dental acrylic. Ultimately, in chronic cases of TMJ instability, a condylectomy may provide definitive treatment.

Finally, fourth tier emergencies require directed care within one to two days. A perfect example of this would be a fractured tooth with pulp exposure in a young patient. Vital pulp therapy (vital pulpotomy) is an option to maintain both tooth function and vitality, if it is performed in a timely fashion. One study examined the long term outcome (36 months) of pulp exposed teeth receiving vital pulpotomies at various time intervals post pulp exposure. Those teeth treated within 48 hours had the best chance of maintaining vitality over the ensuing 36 months (88% of treated teeth remained vital). The vitality percentage dropped dramatically as pulp exposure in the fractured teeth extended beyond seven days (23.5% of treated teeth were vital after 36 months when treated between 1-3 weeks post pulp exposure). Immature teeth with wide open canals may provide greater flexibility in the timing of treatment due to the extensive vascular supply within the pulp. However, treating such cases as dental emergencies still offers these teeth the highest chances for maintaining long term vitality.

**References and selected reading**


Pharyngotomy endotracheal tube placement is indicated when performing oral fracture repair requiring occlusion control or when access to oral structures must be very comfortable. Pharyngotomy is a surgical incision into pharynx performed for placement endotracheal tube or feeding tube. The E-tube is removed immediately after surgical procedure. Pharyngostomy is a surgical formation of artificial opening into pharynx for the same purposes as above but for a longer period of time. List of possible indications for pharyngotomy include: maxillofacial trauma repair, temporomandibular joint luxations, palatal surgery for palatal tumors or cleft palate. Pharyngostomy is performed when the feeding tube will be placed or if there is need for longer presence of endotracheal tube. Both procedures are contraindicated if in surgical area in skin, are present proliferative lesions or other pathologies. Complications of pharyngotomy and pharyngostomy are related to injury to anatomic structures at the area of surgery: tonsils, hyoid bones, jugular vena, salivary glands, lingual arteria as well as hypoglossus nerve. Instrumentation, materials for pharyngotomy and pharyngostomy will be presented and both procedures in a step-by-step manner. Also analogies in human medicine for an extraroral approach to airway will be described as well as indications for this procedure.
Regional oral nerve blocks

Teresa Jacobson

Objective of regional nerve blocks for oral surgery: To control pain.

The dental patient may have periodontal disease, tooth mobility, furcation exposure, fractured teeth, missing teeth, oral masses, and oral nasal fistulas. A plan for pain control is necessary to prevent “wind-up phenomena”. Plans for pre, intra-op and post/home pain control are essential in veterinary dental procedures.

Pain levels

1st Normal Cleaning
2nd Sub-gingival scaling
3rd Simple Extractions
4th Surgical Extractions
5th Maxillary or Mandibular Surgery

World Health Organization (WHO)

Mild – Non-steroidal anti-inflammatories (NSAIDs)
Moderate – NSAIDS & mild opioid
Severe – NSAIDS & Stronger opioid
Refractory – alternate delivery routes like Constant Rate Infusions (CRI)

Nerve blocks should be used as an adjunctive therapy to pain management, not as a substitute. Dental nerve blocks increase patient safety, allow earlier discharge, decrease costs, they are good for client relations and decrease patient morbidity. Do nerve blocks before cleaning to prevent “wind-up phenomena”.

Bupivacaine, Mepivacaine, Ropivacaine and Lidocaine all affect the three areas of the nociceptive pathway: transduction, transmission and modulation. All local anesthetics are Benzocaine’s. Analgesia is accomplished by inhibiting nerve conduction by sodium channel blockade, blocking the transmission of electrical impulses.

The use of benzocaine’s with or without Epinephrine can be hotly debated. Some vets never use Epinephrine because it delays absorption and increases the risk of side effects. Some vets always use Epinephrine because it increases duration of the block. The use of Epinephrine is contraindicated if there is heart disease; hyperthyroidism or if halothane
inhalational anesthesia is used.

The recommended dose is 1 mg/kg and the maximum recommended total dose is 2 mg/kg. Draw up the maximum total dose for small dogs and cats to avoid an accidental overdose.

<table>
<thead>
<tr>
<th>Bupivacaine (with or without Epinephrine)</th>
<th>Lidocaine (with or without Epinephrine)</th>
<th>Mepivacaine</th>
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<tr>
<td>Onset of action</td>
<td>6 – 10 minutes</td>
<td>7 – 15 minutes</td>
</tr>
<tr>
<td>Duration of action</td>
<td>Diffusion 4 – 6 hours</td>
<td>2 hours</td>
</tr>
<tr>
<td></td>
<td>Foramen 6 – 10 hours</td>
<td>2 – 2 ½ hours</td>
</tr>
</tbody>
</table>

Mixing Bupivacaine and Lidocaine is not that beneficial in my opinion. If the blocks are placed appropriately before a dental cleaning begins they have plenty of time to take effect.

If you choose to mix them, proper dose can be achieved by using 0.2 ml of 2% Lidocaine and 0.8ml of 0.5% Buprenorphine per 4.5kg (10 lbs.). The maximum recommended dose of each of these agents is 1 mg/kg.

Use Bupivacaine because it has an acceptable onset of action and a long duration with or without Epinephrine. It is less irritating to the tissues than Lidocaine. It is available in multi-dose vials and ampules.

Complications of Benzocaine administration include hematoma formation, paraesthesia (our patients cannot talk), increased heart rate, dysrhythmia, bronchospasm and in high doses convulsion and tremors.

Adding Buprenorphine to Bupivacaine in the same syringe will prolong the duration of the regional nerve block. The dosage of Buprenorphine is 0.003mg/kg added to Bupivacaine at 1mg/kg. This is especially helpful in cats for full mouth extractions.

**Equipment**

- Luer lock 1 ml syringes
- Aspiration syringe
- Bupivacaine 0.5% ampules
- Bupivacaine 0.5% multi-dose vial
- 27G x 1 ¼ inch needles for the appropriate syringes

**Anatomy**

The mandibular and the maxillary branches of the trigeminal nerve (cranial nerve V) divide at the base of the brain.

In mesiocephalic and dolichocephalic dogs, four nerve blocks are commonly used. They are the infra-orbital, maxillary, middle mental and inferior alveolar.

In cats and small dogs two nerve blocks are commonly used; they are the maxillary and the inferior alveolar. The infra orbital is used rarely as if it is not skillfully done it may cause orbital trauma. The middle mental foramen is not done as it is too small and attempting it in small cats and dogs will traumatize the neurovascular bundle.
**Infraorbital Foramen**

Landmarks are mesial to the mesio-buccal root of the maxillary 4th premolar. Retract the upper lip dorsally to palpate the foramen. The neurovascular bundle exits the canal and courses rostro-dorsally. Advance the needle parallel to the maxillary bone. The needle should pass without hitting bone. Just the tip of the needle should enter the opening of the canal. Inject with a finger over the canal and hold for thirty seconds. This blocks the incisors, canines and the first three premolars, the bone and surrounding soft tissues on the corresponding side.

**Middle Mental Foramen (Rostral Mandibular)**

Retract the mandibular labial frenulum with one hand. The foramen is located 1/3 of the distance of the ventral border of the mandible at the level of the mesial root of the second premolar. This is impossible to do in small dogs and cats. With the other hand guide the needle just caudal and slightly ventral. Inject very slowly as there is very little room here. Inject with a finger over the injection site and hold for 30 seconds. This will block the incisors and canine tooth on the corresponding side along with the bone and soft tissues.

**Caudal Maxillary Block (Pterygopalatine Fossa or Superior Alveolar)**

The eye lives here (cats especially)! Open the patient’s mouth, retract the lip commissure caudally. Advance the needle dorsally perpendicular to the plane of the palate. Penetrate mucosa buccal and distal to maxillary 2nd premolar (distal buccal to the palatine fossa). Advance the needle 3 – 5 mm depending on the patient size. Always aspirate before injection. This is a diffusion block therefore you do not need digital pressure post injection. You can inject faster because it is a diffusion block. This blocks the branches of the maxillary nerve: the infraorbital, the pterygopalatine, and the major and minor palatine nerves. This blocks the teeth, bones (including the hard and soft palate) and soft tissues of the upper jaw on the corresponding side.

**Caudal Mandibular Block (Inferior Alveolar Block) Intraoral Technique**

This nerve is blocked before its entry into the canal. The landmarks are the angular process and the base of the ramus of the mandible. Enter at the lingual side of the mandible. Place your thumb on the base of the ramus of the mandible and the index finger on the angular process. Keep the needle close to the bone across the diagonal in the line with the thumb and index finger. The needle is advanced ½ - 2/3s down the mandible. This will block all mandibular teeth, bone and associated soft tissues on the corresponding side rostral to the injection site.

**Caudal Mandibular Block (Inferior Alveolar Block) Extraoral Technique**

Palpate the indentation on the ventral border of the mandible just cranial to the angular process. Use the same angle as the lateral canthus of the eye. Pass the needle lingual on the caudal aspect of the indentation just rostral to the angular process. The needle enters along the bone until it reaches 1/3 of the distance from the ventral to the dorsal mandibular body.
In summary: Do not give more Benzocaine than needed or recommended as the side effects increase with increased dosages. You may freeze the tongue or cause neuropraxia. Always calculate the toxic dose! Do not inject as pulling out the needle and do not move the needle around.

Guidelines

Large dogs (Lab) 0.3 – 0.4 ml/block
Medium dogs (Beagle) 0.2 ml/block
Small dogs (Yorkie) and cats 0.1ml/block

References


“Pain level is considered the fifth vital sign in human patients, because animals feel and anticipate pain by similar mechanisms as people do, emphasis on pain management should also apply to animals. Continual painful experience in any animal is detrimental to the overall healing process and to the general well being of any animal.

Pain often results in a prolonged hospital stay and increases the potential for secondary problems. Because there may be a link between acute pain and chronic pain in human beings with the hypothesis that if the acute pain were better controlled, the chronic pain would not develop, this is also another factor to consider in animals. Above all, the inhumane aspects of this unnecessary experience should govern one’s actions.

NSAIDs should not be administered to patients that have acute renal insufficiency, hepatic insufficiency, dehydration, hypotension, conditions associated with low “effective circulating volume,” coagulopathies, evidence of gastric ulceration, or gastrointestinal disorders of any kind. NSAIDs should never be administered to patients in shock, trauma cases on presentation, or patients with evidence of hemorrhage.1

Opioids are considered a safe alternative for postoperative pain management. Fifty percent to 60% of anesthesia-related deaths in dogs and cats occur postoperatively; particularly in the first 3 hours of the postoperative period. Strict observation of patients from extubation to unassisted standing ensures maximum patient safety. Preemptive analgesia and regional nerve blocks decrease or eliminate the need for additional analgesics in the immediate postoperative period.

**Lidocaine**

In addition to the local anesthetic effects, lidocaine has been shown to alleviate neuropathic pain and hyperalgesia and to reduce opioid requirements after surgery when administered as a CRI. When indicated, the use of a 2-mg/kg bolus of lidocaine, followed by 1 to 2 mg/kg/h for analgesia in these dogs, may be of value for up to 24 hours. The drug should not be administered to sick cats or cats under anesthesia because it causes significant cardiovascular depression in that species.
Regional blocks

The combination of local anesthetics with opioids as a combined administration considerably lengthens the duration of the pain reduction right at the spot where the procedure has been performed.

Gabapentin

Gabapentin is a structural analog of g-aminobutyric acid used in human patients for management of neuropathic pain associated with diabetes, cancer, or primary nerve compression. Gabapentin is also useful in treating animals after cardiopulmonary arrest or seizures that are extremely restless, disoriented, vocalizing, or manic. There is an extremely wide dose range for gabapentin, and it should be given to effect. Signs of overdose are reduced activity and excessive sleepiness, progressing to depression. Tapering the dose down is important, because stopping the drug abruptly may lead to rebound pain that may be severe. A common starting dose is 2 to 5 mg/kg twice a day, adjusted upward if needed or downward if sedation or ataxia develops.

Reuptake inhibitors

Amantadine is an antiviral medication that is used to treat Parkinson disease. It is a monoamine reuptake inhibitor and an NMDA receptor antagonist. It can be used together with other analgesics to treat chronic pain.

Amitriptyline (Elavil) is a tricyclic antidepressant that possesses several beneficial analgesic mechanisms, including the inhibition of serotonin and norepinephrine reuptake and NMDA receptor antagonism. It is most commonly used combined with other analgesics for chronic pain. This analgesic has numerous interactions with other medicines. Sedation and anticholinergic effects are common.

Tramadol (Ultram) is a serotonin and norepinephrine reuptake inhibitor with some agonist activity, generally used in together with NSAIDs or opioids for chronic and postoperative pain management in dogs and cats. It is considered a safe and effective analgesic.

Opioids

Useful agents include methadone in dogs and cats, and fentanyl and buprenorphine in cats and small dogs. Methadone is an inexpensive choice for large dogs. Methadone has a long lasting effect as a single dose (6 hours). Fentanyl is particularly useful when the clinician plans to transition the patient to a fentanyl patch, the infusion rate of fentanyl is adjusted to reach optimal effect before a patch is applied; the infusion is then tapered and discontinued over the next 8 to 24 hours while observing patient response. If the patient does well on the infusion but poorly when transitioned to the patch, failure of the patch should be suspected. A 25-mg patch provides approximately 10 mg/h of fentanyl to healthy cats, but delivery is highly variable. For small cats, a 12.5-mg patch is available.

Ketamine

The role of ketamine in post injury analgesia is presently unclear. Small studies addressing its use in veterinary patients suggest that it might have some benefits.
### Analgesic agents commonly used as continuous IV infusions

<table>
<thead>
<tr>
<th>Drug</th>
<th>Species</th>
<th>Infusion Rate</th>
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<tbody>
<tr>
<td>Morphine/methadone</td>
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<tr>
<td>Hydromorphone</td>
<td>Canine</td>
<td>0.0125–0.05 mg/kg/h</td>
</tr>
<tr>
<td>Buprenorphine</td>
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<tr>
<td></td>
<td>Feline</td>
<td>1–3 mg/kg/h</td>
</tr>
<tr>
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<tr>
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</tr>
<tr>
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</tr>
<tr>
<td>Ketamine</td>
<td>Both</td>
<td>0.2–0.6 mg/kg/h</td>
</tr>
</tbody>
</table>

### General care

It is important that the patient be made comfortable, clean, warm, and dry.

### References

3. M. Shelby; Small Animal anesthesia techniques; Wiley Blackwell 2014
4. Alex Dugdale; Veterinary anesthesia; principles to practice; Wiley Blackwell 2010
5. Doris Dyson; Analgesia and chemical restraint; Vet Clin North Am Small Anim Pract 2005
Step 1: OBTAIN CONSENT

NEVER extract teeth without owner consent (preferably written), no matter how bad the problem, or how obvious the decision is. Make sure that you have a valid daytime number (or numbers) for the client and inform them they must be available during surgery hours. Consider loaning pagers to clients for the day, as this author has found this to be a very effective means to contact clients. If the client cannot be reached and prior consent was not obtained, DO NOT PULL THE TOOTH. Document the problem, recover the patient, and reschedule the work. Remember, the tooth can always be extracted later, but it cannot be put back in!

Step 2: DENTAL RADIOGRAPHS

Dental radiographs should be exposed on all teeth prior to extraction. Dental radiographs are invaluable resources for the practicioner. Radiographs allow the practitioner to determine the amount of disease present, any root abnormalities or ankylosis. Help with radiographic interpretation is available while the patient is under anesthesia at www.vetdentalrad.com. In addition, the radiographs will serve as evidence for the extraction in the medical record. Radiographs should also be exposed post-extraction to document complete removal of the tooth.

Step 3: OBTAIN PROPER VISABILITY AND ACCESSABILITY

The patient should be positioned in such a way as to allow maximum visibility of the area as well as make the surgeon most comfortable. Note that during the extraction procedure the ideal position may change and the patient should be adjusted appropriately. The lighting should be bright and focusable on the surgical field. Suction, air/water syringes, and gauze should be utilized continually to keep the surgical field clear, and mouth gags can be used to hold the mouth in proper position for surgery. Finally, magnification may help the surgeon locate furcations or retained root tips.
**Step 4: PAIN MANAGEMENT**

Extractions are surgical procedures and are moderately to severely painful for the patient. Depending on patient health, a multimodal approach (combination of opioids, NSAIDs, local anesthetics, and dissociative) should be employed, as this provides superior analgesia. Preemptive analgesia is proven to be more effective than post-operative, and it is therefore important to administer the drugs BEFORE the painful procedure.

**SINGLE ROOT EXTRACTIONS**

**Step 5: INCISE THE GINGIVAL ATTACHMENT**

This is accomplished with a scalpel blade (number 11 or 15), elevator, or luxator. The selected instrument is placed into the gingival sulcus with the tip of the blade angled toward the tooth (this will help avoid going outside the bone and creating a defect or cutting through the gingiva). The blade is then advanced apically to the level of the alveolar bone, and the instrument is carefully worked around the entire tooth circumference.

This step is very helpful as the gingival attachment contributes approximately 15% of the retentive strength of the periodontal apparatus. More importantly, however, this procedure will keep the gingiva from tearing during the extraction procedure. This is most important with mobile teeth where little elevation is needed, but one edge is still attached. Gingival tearing can cause defects that require closure or can make a planned closure more difficult.

**Step 6: ELEVATE THE TOOTH**

Elevation is the most dangerous step in the extraction procedure. Remember that you are holding a sharp surgical instrument and working in an area of numerous critical and delicate structures. There have been many reports of eyes that have been gouged and lost by extraction instruments as well as at least one confirmed fatality due to an elevator puncturing a patient’s brain. The index finger is placed near the tip of the instrument to avoid causing iatrogenic trauma in the event of instrument slippage or encountering diseased bone. In addition, the jaw should be gently held with the opposite hand to provide stability and avoid mandibular fracture.

First, select an instrument which matches the curvature and size of the root. There are numerous instruments available including the classic elevator, the luxating elevator, and the winged elevators. Classic elevators and winged elevators are used in an “insert and twist” motion to tear the periodontal ligament, whereas luxators are used in a rocking motion during insertion to fatigue as well as cut the periodontal ligament. Luxators can be GENTLY twisted for elevation, but they are not designed for this and can be easily damaged when used in this manner.

Elevation is initiated by inserting the elevator or luxator firmly yet gently into the periodontal space. The insertion should be performed while keeping the instrument at about a 10 to 20 degree angle toward the tooth, to avoid slippage. Once in the space between the bone and the tooth, the instrument is gently twisted with two-finger pressure. This is not to say that the instrument should be held with two fingers, rather the entire hand should be used to hold the instrument. Twist only with the force that you could generate when holding with two fingers. Hold the position for 10-30 seconds to fatigue and tear the periodontal ligament.
It is important to note that the periodontal ligament is very effective in resisting intense, short forces. It is only by the exertion of prolonged force (i.e. 10-30 seconds) that the ligament will become weakened. Heavy stresses only serve to put pressure on the alveolar bone and tooth which can result in the fracture of one of these structures, so it is important not to use too much force.

After holding for 10 to 30 seconds, reposition the instrument about 1/8 of the way around the tooth and repeat the above step. Continue this procedure 360 degrees around the tooth, each time moving the elevator apically as much as possible. Depending on the level of disease and the size of the tooth, a few to several rotations of the tooth may be necessary.

The key point to successful elevation is PATIENCE. Only by slow, consistent elevation will the root loosen without breaking. It is always easier to extract an intact root than to remove fractured root tips.

**Step 7: EXTRACT THE TOOTH**

Removing the tooth should only be attempted after the tooth is very mobile and loose. This is accomplished by grasping the tooth with the extraction forceps and gently pulling the tooth from the socket. Do NOT apply undue pressure as this may result in root fracture. In many cases, especially with premolars, the roots are round in shape and will respond favorably to gentle twisting and holding of the tooth while applying traction. This should not be performed if there are root abnormalities (significant curves, weakening) seen on the pre-operative radiograph.

It is helpful to think of the extraction forceps as an extension of your fingers. Undue pressure should not be applied. If the tooth does not come out easily, more elevation is necessary. Start elevation again until the tooth is loose enough to be easily removed from the alveolus.

**Step 8: AVELOPLASTY**

This step is performed to remove diseased tissue or bone, as well as rough boney edges that could irritate the gingiva and delay healing. Diseased tissue can be removed by hand with a curette. Bone removal and smoothing is best performed with a carbide, or preferably a coarse diamond bur on a water-cooled high-speed air driven hand-piece. Alternatively, ronguers or bone files may be used if a high-speed dental unit is unavailable. Next, the alveolus should be gently flushed with a 0.12% chlorhexidine solution to decrease bacterial contamination. After the alveolus is cleaned, it may be packed with an osseopromotive substance.

**Step 9: CLOSURE OF THE EXTRACTION SITE**

This is a controversial subject among veterinary dentists, and thus some texts recommend suturing only in large extractions, other authors (including this one) recommend suturing almost all extraction sites. Closure of the extraction site promotes hemostasis and improve post-operative discomfort and aesthetics. It is always indicated in cases of larger teeth (e.g. canines, carnassials), or any time that a gingival flap is created to allow for easier extraction. This is best accomplished with size 3/0 to 5/0 absorbable sutures on a reverse cutting needle. Closure is performed with a simple interrupted pattern with sutures placed 2 to 3 mm apart. It is further recommended to utilize one additional throw
over manufacturer’s recommendations to counteract tongue action.

In regards to flap closure, there are several key points associated with successful healing. The first and most important is that there must be no tension on the incision line. If there is any tension on the suture line, it will not heal. Tension can be removed by extending the gingival incision along the arcade (called an envelope flap) or by creating vertical releasing incisions and fenestrating the periosteum. The periosteum is a very thin fibrous tissue which attaches the buccal mucosa to the underlying bone. Since it is fibrotic, it is inflexible and will interfere with the ability to close the defect without tension. The buccal mucosa is very flexible and therefore will stretch to cover large defects. If there is no tension, the flap should stay in position without sutures.

If at all possible, the suture line should not be made over a void. If sufficient tissue is present, consider removing some on the attached side to make the suture line over bone. Always suture from the unattached (flap side) to the attached tissue, because this avoids tearing the flap as the needle dulls. Finally, ensure that all tissue edges have been thoroughly debrided as intact epithelial tissues will not heal.

**EXTRACTION OF MULTI ROOTED TEETH**

Section all multi-rooted teeth into single rooted pieces. The roots of almost all multi-rooted teeth are divergent and this will cause the root tips to break off if extractions are attempted in one piece. Root fracture can occur even if a tooth is relatively mobile to start with. With mobile teeth, the sectioning step alone often allows for simple extraction.

The best tool for sectioning teeth is a bur on a high-speed air driven hand piece. Besides being the quickest and most efficient tool for the job, it also has air and water coolant that will avoid overheating the tooth. Many different styles of burs are available, however this author prefers a cross-cut taper fissure bur (699 for cats and small dogs, 701 for medium dogs and 702 for large breeds).

The best way to section the teeth is to start at the furcation and work towards the crown of the tooth. This method is used for two major reasons. First, it avoids the possibility of missing the furcation and cutting down into a root, which subsequently weakens the root and increases the risk of root fracture. In addition, this method avoids the possibility of cutting through the tooth and inadvertently damaging the gingiva or alveolar bone.

After the tooth has been properly sectioned, follow the above steps for each single rooted piece. In some cases, the individual tooth pieces can be carefully elevated against each other to gain purchase.

**SURGICAL EXTRACTIONS**

The more difficult extractions are best performed via a surgical approach. This includes canine and carnassial (maxillary fourth premolar and mandibular first molar) teeth, as well as teeth with root malformations or pathology, and finally retained roots. A surgical approach allows the practitioner to remove a small amount of buccal cortical bone, promoting an easier extraction process.

A surgical extraction is initiated by creating a gingival flap. This can be a horizontal flap along the arcade (an envelope flap) or a flap with vertical releasing incisions (a full flap). An envelope flap is created by releasing the gingival attachment with a periosteal elevator along the arcade including one to several teeth on either side of the tooth or teeth to be extracted. The gingiva along the arcade is released to or below the level of the mucogingival junction (MGJ) and the flap is connected by incising the gingiva in the interdental spaces. The advantage to this flap is that the blood supply is not interrupted and there is
less suturing.

The more commonly used flap includes one or more vertical releasing incisions. This method allows for a much larger flap to be created, which (if handled properly) will increase the defects which can be covered. The vertical incisions are created at the line angle of the target tooth, or one tooth mesial and distal to the target tooth. The incisions should be made slightly apically divergent (wider at the base than at the gingival margin). Furthermore, it is important that the incisions be created full thickness, in one motion (rather than slow and choppy). A full thickness incision is created by incising all the way to the bone, and the periosteum is thus kept with the flap. Once created, the entire flap is gently reflected with a periosteal elevator. Care must be taken not to tear the flap, especially at the muco-gingival junction.

Following the flap elevation, a small amount of buccal bone should be removed (approximately 1/3 to ½ of the root length depending on the situation) to the depth of the root. This should only be performed on the buccal side. Next, the teeth should be sectioned if multirooted and the teeth then extracted as described above. After the roots are removed the alveolar bone should be smoothed and the defect closed.

Closure is initiated with a procedure called fenestrating the periosteum. The periosteum is a very thin fibrous tissue which attaches the buccal mucosa to the underlying bone. Since the periosteum is fibrotic, it is inflexible and will interfere with the ability to close the defect without tension. The buccal mucosa however, is very flexible and will stretch to cover large defects. Consequently, incising the periosteum takes advantage of this attribute. The fenestration should be performed at the base of the flap, and must be very shallow as the periosteum is very thin. This step requires careful attention, as to not cut through or cut off the entire flap.

After fenestration, the flap should stay in desired position without sutures. If this is not the case, then tension is still present and further release is necessary prior to closure. Once the release is accomplished, the flap is sutured normally.
Selected cases of oral and maxillofacial trauma repair

Maria Soltero-Rivera & Alexander M. Reiter

Oral and maxillofacial trauma may present as dentoalveolar injuries, bone fractures, and lacerations, avulsions or burns of the soft tissues. The most common causes of oral and maxillofacial trauma include automobile accidents, animal fights, high-rise falls, iatrogenic trauma, foreign body penetration, biting into electric cords, and projectile injury.

Oral and maxillofacial lesions may be associated with concurrent ocular and intracranial trauma, as well as limb fractures. Pulmonary contusions, internal hemorrhaging, or urinary bladder ruptures may also be seen, thus making complete evaluation and initial stabilization of trauma patients very important. Once the patient is stable, a full assessment including anesthetized oral examination and intraoral radiography are indicated. For caudal mandibular or mid to caudal maxillary fractures computed tomography may aid in determining the extent of the lesions as well as in treatment planning.

Differences in the management of maxillomandibular fractures and fractures of the extremities exist. Proper occlusion and semirigid fixation are the main goals of fracture repair. This may be performed via interdental wiring and splinting, interfragmentary fixation, or internal fixation with miniplates and screws. Maxillary fractures that do not result in occlusion of the nasal passages or significant malocclusions may be treated more conservatively taking into consideration the buttresses that support the face and jaws.

In young patients, or those in which financial concerns or co-morbidities do not allow for more sophisticated treatment, the use of a tape muzzle may be considered. Craniofacial development and growth may be compromised in young patients that have undergone trauma. Selective extractions may be necessary in cases in which traumatic malocclusion resulted after the repair. Salvage procedures such as rostral advancement of the lip commissures and resection of the fractured bony fragments may be considered in cases were a non-union occurs.

Multiple layer closure when repairing lip lacerations may prevent dehiscence, and care should be taken to avoid damage of the salivary ducts when the lesions are near the commissures. Rotational, single pedicle advancement, transpositional, or axial pattern flaps may be used for closure of lip and intermandibular defects. In cases of lip avulsions guide hole placement through the inscive bone or mandibular symphysis as well as interdental, “suspender” sutures, may further strengthen the closure.

Lingual lacerations or avulsions to the extent of even requiring full glossectomies may also be seen. As a short-term complication, dehiscence may occur. In the long-term, pa-
tients requiring extensive glossectomies should be monitored for dysphagia and aspiration pneumonia. Additionally, when larger defects require extensive suturing, necrosis resulting in exfoliation of the rostral portion of the tongue may occur.

Foreign body penetrations are also commonly seen with pharyngeal foreign bodies causing esophageal tears carrying the worst prognosis. In some cases, the foreign body may not be obviously seen requiring exploration of the area and open management to allow for drainage and natural expulsion of the foreign object by the body. Fistulograms may aid in guiding the approach to the exploratory surgery.

This lecture will discuss the pre-, intra- and postoperative management of selected cases of maxillofacial trauma that commonly present in an emergency setting, focusing on soft and hard tissue trauma.
Non-invasive options for jaw fracture repair

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Mandibular and maxillofacial fractures can pose a challenge due to the presence of teeth, vascular and nervous structure in such close proximity in the jaws as well as the need for preservation of normal occlusion with the repair. In an experimental study assessing repair of mandibular fractures with miniplates and screws, 32.5% of screws were found to have caused pulpal damage. This is also a concern when using external fixation devices. Additionally, striping of the periosteum when placing internal fixation devices can further compromise the vascular supply to the fracture fragments.

Although internal fixation may allow for rigid skeletal fixation and consequently early return to function, non-invasive fracture repair can allow for semi-rigid fixation along with a functional and comfortable occlusion with a less aggressive approach. Being that the majority of oral fractures are open, adequate wound management is indicated prior to closure and fixation with any technique used. Additionally, temporary fixation in proper occlusion or alternative methods of intubation for anesthesia maintenance may be required.

Oral fracture repair follows a tension band principle. Maximal tensile stresses exist in the alveolar surface and all fixation devices are strongest under tension thus they are ideally placed on the alveolar surface. Non-invasive options for jaw fracture repair include:

- Maxillomandibular fixation with interarch splinting
- Symphyseal circumferential wiring
- Interdental wiring composite or acrylic splinting
- Muzzling with or without commissuroplasty

Interdental wiring techniques include: Ivy loop, Stout multiple loop, Risdon, and Essig. The number and health of teeth rostral and caudal to the fracture line will greatly influence the viability of interdental wiring and splinting. Indications for extraction of teeth involved in the fracture include direct communication between the intraoral environment and the apex of the tooth, complicated crown fractures, and unstable/mobile teeth. Acutely, there are more indications for preservation of teeth and their use as anchorage. Bis-acryl composite resins have shown to generate a significantly lower degree of heat during polymerization. The composite is applied taking care not to cover the oral mucosa, burying the twisted wire ends, and making the splint smooth to avoid trauma to the soft tissues or accumulation of debris and food in some areas.
Symphyseal circumferential wiring involves the placement of a 24-26 gauge wire around the lower jaw, behind the lower canine teeth being careful to not entrap the lip frenulum, bilaterally. This technique can also be effective in the repair of certain parasymphysyal fractures. In edentulous mandibles, a variation of the circumferential technique, where the wire is looped around the mandibular body, can be used to reinforce splint placement.

Cats pose a challenge in application of interdental wiring techniques due their narrow interproximal spaces, the decreased number of teeth, and the shape of their teeth. Preplacing blebs of composite in the interproximal spaces can aid in holding down the wire prior to tightening. When interdental wiring is not possible, maxillomandibular fixation can be performed by bonding upper and lower canines bilaterally, using a bignathic encircling and retaining device, or employing tension-relieving sutures spanning both jaws.

To provide for additional stability, tape muzzle application or commissuroplasty can be performed. The lip commissures are advanced to the level of the second premolar teeth (uni- or bilaterally, depending on the situation) after excising the pigmented portion of the lip margin. These techniques are helpful in very young patients due to their continued growth, very old patients where multiple anesthetic episodes may be contraindicated, in cases of financial concern, or in those with severe, chronic periodontal disease and a guarded prognosis for other repair methods due to the poor quality of the bone and possible osteomyelitis.

Generally, fixation devices are left in place for 4-8 weeks. Owners are instructed to maintain the appliances clean with daily brushing or rinsing and pets are maintained on soft food for the duration of the treatment. Despite all these efforts, gingivitis is a common sequela of composite or acrylic splint application and some pets may develop a sensitivity to these materials leading to a more severe manifestation of this. Selective extractions may be necessary in cases in which traumatic malocclusion results after the repair. Additonally, sequestrum formation, osteomyelitis, and failure of union may occur. In those cases, mandibulectomy or maxillectomy can be considered as a salvage technique.

This lecture will discuss indications, contraindications, step by step methods, and follow up recommendations for each technique. The current literature on each method will also be reviewed.
Closed and open tooth extraction in cats and dogs

Cedric Tutt

Open and closed extraction techniques describe whether a muco-gingivo-periosteal flap is raised to gain access to the alveolus or if the extraction is performed without raising a flap. Either way tooth extraction (exodontia) is an act of veterinary surgery and should therefore be performed by a veterinary surgeon.

Dental radiography

Dental radiography is a prerequisite part of making a diagnosis and therefore must be performed prior to surgery, intra-operatively (if necessary) and post-operatively. The client’s budget should not be a deciding factor when considering radiography; radiography makes us better veterinary dentists and at times we need to absorb the “cost” because the results enable us to make informed decisions and treat our patients to Gold Standard.

Local / regional anaesthesia and multimodal analgesia

Although these techniques will not be described here, it is important that local / regional anaesthetic blocks are on board prior to the commencement of surgery. It is also important that multimodal analgesic protocols are implemented prior to, intra-surgically and post-surgically. Multi-modal analgesia which includes the use of medications that will prevent “wind-up” have been shown to reduce the post-operative requirement for analgesics.

Exodontia

There are many indications for tooth extractions; sometimes we extract what appear to be completely healthy teeth and at other times “diseased” teeth are extracted. Teeth are also extracted as part of interceptive orthodontics – making space to improve occlusion or removing teeth that are causing trauma and or pain.

1. Simple (closed) extraction technique

Simple extractions are performed without a muco-gingivo-periosteal flap being raised. To deliver the tooth from the alveolus there are a few requirements in addition to radiog-
1. Pattern recognition – know the anatomy of the tooth and adjacent structures,
2. Administer an appropriate local / regional anaesthetic block and make use of multimodal analgesia,
3. Use the appropriate equipment,
4. Exercise patience!

When extraction of a single rooted tooth is indicated the periodontium associated with the tooth must divided between the alveolar wall and cementum. The gingiva and alveolar bone must be separated from the cementum by sacrificing the periodontal ligament. Sharp luxation instruments may be used to sever the gingival attachment and part of the coronal periodontal ligament, or this may be performed using a 15 or 15c scalpel blade on a scalpel handle. Once this has been done, the luxation instrument must be driven between the root and alveolus, systematically incising the periodontal ligament circumferentially. Do not be tempted to work on one or two sides of the tooth only – remember, in health, the periodontal ligament is what secures the cementum to the alveolar bone, doing a pretty good job maintaining the teeth in their normal positions. The luxation instrument should be driven successively deeper into the alveolus until the whole periodontal ligament is severed. The luxation instrument not only severs the ligament, but also compresses the alveolar bone, making space for the use of the more robust elevator. The elevator can be used to deliver the tooth from the alveolus by applying rotational forces, further destroying the attachment between the tooth and the alveolus. The use of extraction forceps will be discussed later. Once the tooth has been delivered a gauze swab can be inserted into the alveolus and used to remove all blood to enable direct visualisation of the complete alveolus (It is contra-indicated to squirt water or blow air down the alveolus to help visualisation – the alveolus tapers and the velocity of the air and or water is increased and therefore the air and or water may breach the apical delta, or worse enter a patent blood vessel that may still be attached to a root fragment, resulting in emphysema or embolus). A post-operative radiograph can be taken at this point. Once the extirpation of the alveolus is confirmed, the gingiva should be lifted from the alveolar margin to enable removal of sharp shards of bone that make puncture the gingiva or alveolar mucosa at a later stage. The sharp bone can be removed using a low or high-speed handpiece (do not direct the water jet of the high speed unit down the alveolus) and round or oval diamond bur of appropriate diameter; smaller for small dogs and cats and larger for medium and large dogs. Rongeurs may also be used to perform alveoloplasty. When the bony margins have been smoothed, apposition of the gingiva should be attempted. If the gingiva can close over the defect without tension it should be sutured closed. If however, the tissues are stretched over the void, a releasing incision should be made through the sub-mucosal periosteum to enable the soft tissue to be mobilised over the defect. Under some circumstances, the gingival margin may need to be trimmed due to tissue compromise, or the flap repair may break down. Any epithelialized tissue on the aboral side of the gingiva must be debrided or it will compromise the knitting of the soft tissues. Suturing using synthetic, monofilament, absorbable material that is hydrolysed rather than phagocytosed is optimal, Gold Standard.

Periodontally compromised multi-rooted teeth may also be extracted using the closed extraction technique, however the teeth must be sectioned into as many crown-root sections as there are roots. Each crown-root fragment is luxated, elevated and delivered from the alveolus as previously described. It is beneficial to luxate all parts in turn and progressively, rather than delivering each part prior to luxating others. Preparation of the alveolar margin and flap should be performed as described previously, followed by closure in a
tension free manner.

In young animals, the teeth are more inclined to "bend" during extraction than they are in older animals. This may be due to the fact that younger teeth have thinner dentine and older teeth are inclined to have sclerotic dentine and fracture rather than bending when rotational forces are applied to them during extraction.

2. Open extraction technique

When pre-operative radiographs have been obtained to show root presence, morphology, number and width of the PDL, the surgical plan can be formulated.

In the open extraction technique, a muco-gingivo-periosteal flap is raised to reveal the alveolar bone enabling alveolotomy and access to the periodontal ligament, to facilitate tooth luxation. The flap must be designed in such a way that the blood supply is maintained and the soft tissue envelope is protected from intra-operative trauma.

Although planning a surgical extraction comes as second nature to the experienced "oral surgeon", it takes a while to develop this skill. Knowledge of the gross and radiographic anatomy is essential.

Prior to raising the muco-gingivo-periosteal flap, the gingival attachment around the tooth should be severed using a scalpel blade, periosteal elevator or a dental luxator, to reflect the gingiva and reveal the furcation area. The tooth should then be sectioned using a high-speed hand piece with a pear-shaped, round or fissure bur. Two rooted teeth should be sectioned from the furcation to the occlusal surface, removing a wedge of crown. If crown sectioning is performed perpendicular to the furcation, a long lever will be created on either side of the section line and there is a high risk of crown-root fracture when an instrument is placed between both parts. It is therefore preferable to remove a wedge of crown to reduce the levers and also create direct access to the ligament space on the mesial side of the distal root and the distal side of the mesial root. Once the crown has been sectioned into as many crown-root fragments as there are roots, the muco-periosteal flap may be raised to expose the juga of the teeth to be extracted. When adequate care has been taken to protect the flap, a low speed hand piece with internal coolant can be used to perform alveolotomy and alveolectomy, creating space around the roots of the teeth / tooth to be extracted. A low speed hand piece is preferable as it is unlikely to induce emphysema and air embolism. The periodontal ligament (PDL) space can be enlarged using a ½ round bur – this not only destroys the periodontal ligament but also creates more space to insert the luxation instrument.

After the alveolotomy, with the jaw supported by the non-dominant hand, a luxation instrument is placed in the periodontal ligament space and driven as far apically as possible. Initially a wriggling motion may be required whilst driving the instrument apically. The instrument is left engaged for 10-20 seconds before being removed and replaced at another site in the PDL space and driven apically as before. This procedure is performed circumferentially around each crown-root fragment being extracted. Once all fragments have been subjected to some luxation the process is begun again from the first fragment. It is possible that some fragments may already be loose enough to extract at the second attempt. Again, each fragment must undergo further luxation, with the luxation instrument being driven further apically in the PDL space each time. With compression of the alveolar bone by the luxation instrument, space is created for insertion of an elevator. Elevators are more robust than luxation instruments and rotational shearing forces can be applied between the alveolar bone and root, further loosening the tooth. Some crown-root fragments will loosen quicker than others and they will be delivered from their alveoli sooner. When all crown-root fragments have been successfully delivered a post-operative radiograph should be taken to confirm complete extraction. Alveolo-plasty should be performed to
remove sharp marginal bone that may puncture the flap after closure. After rounding the bone place the buccal muco-gingivo-periosteal flap where it needs to be and if it meets the gingiva from the lingual aspect and remains in position, it should be sutured as previously described. If the flap retracts, a periosteal incision should be made beneath the alveolar mucosa to facilitate tension-free closure.

3. **Crown amputation**

Crown amputation is the third type of surgical extraction and may only be performed where indicated by radiographic evaluation of the teeth. Teeth that have undergone extensive Type II replacement resorption are the only teeth that can be treated in this manner and the extraction site needs to be re-evaluated radiographically on a regular (3-6 monthly) basis.

Where crown amputation has been confirmed as the extraction technique, the gingiva of the affected tooth is carefully reflected and retracted so that the crown can be amputated using a high-speed hand piece and bur. Initially the tooth is amputated at the alveolar margin and then the remaining tooth substance is reduced about 0.5 – 1 mm below the alveolar margin. The flap is expanded buccally and lingually / palatally and a small releasing incision is made through the alveolar mucosal periosteum enabling the flap to be advanced to close the defect without tension. A single cruciate suture will usually provide adequate closure.

**Forceps assisted extraction**

Most extraction forceps on the market are designed to grip human teeth. There are however some designs that may be useful in veterinary dentistry. Forceps are not for “pulling” teeth! Once the crown-root fragment has been luxated to a certain extent, the forceps should be applied to the neck of the tooth and the fragment firmly grasped. Initially an intrusive force must be applied to further tear the periodontal ligaments. While maintaining the intrusive force the root should be rotated gently in a clockwise then anti-clockwise manner to break the ligament attachments even further. At the end of each twist the force should be sustained for 5-10 seconds, further fatiguing the ligaments. Thereafter an attempt should be made at delivering the root from the alveolus, in an extrusive twisting manner. If the tooth is not immediately delivered, go back and further luxate and elevate the root before attempting to deliver the root again, using forceps. It may be necessary to refresh one’s memory of the root structure by reviewing the radiograph if the root continues to resist delivery. Bending forces should not be applied to the root as this often results in root fracture.

**Additional reading**


Periodontal flap surgery

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Introduction

Any pocket with depths greater than normal (for the species) are pathologic and in need of therapy. These are present in the vast majority of patients and represent not only an opportunity to improve patient health, but also to increase practice income. A thorough oral exam will elucidate these pockets and allow for proper therapy.

Periodontal therapy/surgery involves removing the infection from the root surface (i.e. plaque, calculus, and granulation tissue), as well as smoothing the diseased root surface. These steps allow for gingival reattachment leading to a decrease in pocket depth.

In dogs, pockets between 3 and 6 mm which are not associated with tooth mobility or other pathology (furcation, root caries) are best treated with closed root planing and subgingival curettage. This step is performed with a combination of mechanical and hand scaling. This should be meticulously performed in order to achieve as clean a tooth as possible to promote healing. Following this, periocuetic can be administered to improve attachment gain.

Pockets greater than 5 to 6-mm require advanced procedures for effective cleaning, owing to the fact that residual calculus is seen with regularity in pockets greater than 6-mm. In humans this is known as the 5-mm standard. In addition, periodontal surgery is indicated for teeth with even moderate alveolar bone loss, furcation level II and III, and inaccessible areas. Visualization is best accomplished via periodontal flap procedures, which should be offered if the clients are interested in salvaging the teeth. These are advanced procedures, but can be learned by general practitioners.

Periodontal surgery is very effective for treating regaining attachment and salvaging teeth. However, without a commitment to regular periodontal care (consistent homecare and professional cleanings), these surgeries will ultimately fail. This should be communicated to the client prior to performing surgery.

Since these are involved procedures and are generally performed on older patients, a complete work-up prior to surgery is strongly recommended. In addition, proper pain management, including regional anesthesia is mandated for proper patient care.
**Equipment needs**

All incisions for periodontal surgery are best accomplished with a number 15 or 11 scalpel blade. Other equipment should include a selection of periodontal elevators, several sharp curettes, 7 x 7 tissue forceps, and small needle holders. It is recommended to have all of this as well as a sharpening stone in a sterile pack. Suture should be swedged on a reverse cutting needle and should be absorbable and fine (6-0 to 4-0).

In those cases where bone augmentation is desired/indicated, materials for guided tissue regeneration is necessary. This should include at minimum an absorbable barrier membrane\(^a\)\(^b\). In addition, bone grafting/augmentation products are recommended. At this point, the highest rated material is a demineralized freeze-dried bone allograft\(^c\), but many other options exist.

**Surgical preparation**

All surgery should initiate with a complete dental prophylaxis to decrease oral contamination. Ideally, this is performed a few weeks prior to the surgical procedure. Following this, a complete oral exam is performed. This should include the visual as well as tactile senses. Tactile evaluation consists of a combination of periodontal probing and sounding. Finally, dental radiographs should be exposed of the surgical area to document attachment levels.

**The sulcal incision**

The sulcal incision is created reverse bevel. This means that the blade is angled AWAY from the tooth on approximately a 45 degree angle. This is designed to remove the diseased pocket epithelium. It is a more difficult incision to create, but will make the cleaning as well as suturing easier. Once the reverse bevel incision is performed, the rest of the flap is created.

**Flap types**

There are numerous options for flaps, depending on the presentation. The most common flap used in periodontal surgery is a full flap, or one with vertical releasing incisions. This allows for increased exposure, however is somewhat more invasive. The other common flap for periodontal surgery is the envelope flap. This is created along the arcade, without vertical incisions.

**Envelope (horizontal) flap**

The advantage of this flap is that there is less chance for dehisance and there is less suturing than for a full flap. The only disadvantages are that there may not be as much exposure for cleaning the surface of the root. Also, repositioning is not possible without vertical releasing incisions.\(^e\) envelope flap is created by first performing the reverse bevel incision along all diseased teeth. Once this is accomplished, the gingiva between the target teeth is incised. The incision should be made in one motion all the way down to the alveolar bone.

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\(^a\) Ossiflex: Veterinary Transplant Services. Seattle WA.
\(^b\) Atrisorb.
\(^c\) Periomix osteoallograft. Veterinary Transplant Services. Seattle WA.
This will create a full thickness flap. The incision can be carried to adjacent healthy teeth, if necessary for sufficient exposure. Make sure when you are performing this flap to not damage the gingiva.

After the extent of the horizontal flap is created, the flap is elevated from the alveolar bone. It is important to ensure that the entire flap is fully cut prior to attempting release. If there is a small area of attachment, it could result in tearing. Start elevation slowly and if significant resistance is felt, re-incise the area. This is best performed with a sharp periosteal elevator. Carefully release the full thickness flap to expose the root surface and alveolar bone for cleaning and contouring. Following therapy (see below), the flap is replaced (without tension) and sutured interdentally.

**Full flap**

The full flap is once again initiated by performing a reverse bevel incision around the target tooth (teeth). Once accomplished, vertical releasing incisions are created mesial and distal to the area. These incisions should be made very slightly divergent (so that the base is slightly wider than the gingival area) to maintain blood supply. Additionally, the incisions are typically made on line angles of the target teeth or one mesial and distal to the target tooth (teeth). Line angles are theoretic lines where two edges of a tooth meet. In general, the incisions are made on medial and distal line angles. If there is a diastema between the teeth (most notable distal to the canine teeth) an interdental incision may be made. Incisions should never be made mid root as this will damage the periodontal attachment.

After the extent of the flap is created, it is elevated from the alveolar bone. This is best performed with a sharp periosteal elevator. Carefully release the full thickness flap to expose the root surface and alveolar bone for cleaning and contouring. Following therapy (see below), the flap is replaced (without tension) and sutured interdentally. The vertical incisions are closed with simple interrupted sutures placed 2-3 mm apart.

Full flaps can also be sutured at different levels on the tooth. Apical repositioned flaps are utilized to move the gingival height apically, thus decreasing pocket depth. These flaps are most commonly used in the mandibular incisor area. Coronal repositioning flaps are used to move the gingival attachment up the tooth. This is used to move the attachment up the tooth to gain attachment levels. This results in increased attachment, but may also result in increased pocket depth.

**Treating the exposed root/bone surface**

The goal of periodontal surgery is to create a smooth and clean tooth surface for reattachment. This is comprised of several steps.

The first and most important step is thorough root planing. This is best performed with a combination of ultrasonic and hand scaling. This author prefers utilizing the ultrasonic scaler on the root surface to remove the vast majority of the plaque and calculus. Following this, a sharp curette is used to plane the exposed root surface to as smooth as possible a finish.

Following the root planing, the remaining alveolar bone is smoothed to a knife sharp edge. Additionally, the bone should scalloped around the tooth. This can be performed with a bone chisel or a finishing bur.

Next, root conditioning is performed. This step is designed to clean the root surface as well as slightly demineralise it to improve reattachment. There are many products that have been or can be used for this step. Classically it was performed with citric acid, but recently EDTA has been promoted as the best product. Following manufacturers recom-
mendations, it is placed on the exposed root surface and left for the prescribed time. After that, it is rinsed from the surface.

If bone augmentation is indicated, it is mixed according to manufacturer’s directions and placed in the defect. There are numerous products available; the practitioner must make their own decision based on cost. However, currently, the product with the best track record for regrowth is freeze dried, demineralized cancellous cadaver bone.

A barrier membrane should be placed over the surgical site, if bone regrowth is desired. In veterinary medicine, absorbable membranes should be utilized. There are several types and manufacturers; this author finds that the lamellar bone membrane works well. Another option for the barrier membrane is to create one out of a perioceutic. This has the added advantage of the antibiotic and anti-inflammatory properties of the product. To perform this, place a small amount of properly mixed Doxirobe on a glass slab. Thin the product with air and then wet it. Once set, use a scalpel blade to cut out the correctly sized and shaped membrane. Then carefully lift the membrane and suture in place.

**Follow-up**

The patient should be prescribed antibiotics and pain management and fed soft food for 2 weeks. At the end of 2 weeks, the patient should be rechecked to ensure that the flap has healed. The owner should be counselled on home care and recheck needs. The patient should be rechecked in six months to determine success or failure of the procedure. This recheck should be performed under general anesthesia and include probing and radiographic monitoring of the surgical site.

**Conclusion**

Periodontal disease is the number one diagnosed problem in small animal dentistry. More clients are interested in salvaging these teeth, and periodontal surgery can provide this benefit. By learning these procedures, general practitioners can provide this service under one anesthetic.
A lot has been written about malocclusion – whether the malocclusion is or is not genetic, whether it is genetically transmissible, or acquired. We will try to determine the differences, and the source of these different theories and pseudo-theories – many having originated with original breeders of dogs. In this presentation, we will dissect each theory and its principals and try to determine how they all relate. We will also talk about what we consider treatable malocclusion and propose methodologies for treatment.
An ideal occlusion can be described as perfect interdigititation of the upper and lower teeth. In the dog, the ideal teeth positions in the arches are defined by the occlusal, inter-arch and interdental relationships of the teeth of the archetypal dog (i.e. wolf). This ideal relationship with the mouth closed can be defined by the following:

The maxillary incisor teeth are all positioned rostral to the corresponding mandibular incisor teeth. The crown cusps of the mandibular incisor teeth contact the cingulum of the maxillary incisor teeth. The mandibular canine tooth is inclined labially and bisects the interproximal (interdental) space between the opposing maxillary third incisor tooth and canine tooth. The maxillary premolar teeth do not contact the mandibular premolar teeth. The crown cusps of the mandibular premolar teeth are positioned lingual to the arch of the maxillary premolar teeth. The crown cusps of the mandibular premolar teeth bisect the interproximal (interdental) spaces rostral to the corresponding maxillary premolar teeth. The mesial crown cusp of the maxillary fourth premolar tooth is positioned lateral to the space between the mandibular fourth premolar tooth and the mandibular first molar tooth.

Malocclusions can be divided into skeletal and dental (alveolar). Malocclusions are subdivided into symmetrical and asymmetrical. They can affect both the length and the width of the jaws.

Symmetrical malocclusions are divided into three basic types:

Dental/alveolar/type is

Neutroclusion (Class 1 malocclusion; MAL 1): A normal rostral-caudal relationship of the maxillary and mandibular dental arches with malposition of one or more individual teeth.

Skeletal types are following two:

Mandibular distoclusion (Class 2 malocclusion; MAL 2): An abnormal rostral-caudal relationship between the dental arches in which the mandibular arch occludes caudal to its normal position relative to the maxillary arch.

Mandibular mesioclusion (Class 3 malocclusion; MAL 3): An abnormal rostral-caudal relationship between the dental arches in which the mandibular arch occludes rostral to its
normal position relative to the maxillary arch.

(Definitions of Ideal occlusion and Class 1,2,3 malocclusion are references from AVDC websites.)

The skeletal symmetrical malocclusion, affecting the width of the jaw, is undoubtedly a phenomenon

**Mandibula Angusta** (narrow mandible, MA) - lower dental arch is far narrower than normal when compared to the upper dental arch /contributing to much more pronounced anisognathism than normal/. This condition may occur simultaneously with any of the aforementioned types of malocclusion (MAL 1,2,3) and one of its consequence can be linguoversion of the canines. If mandibular canines at MA are in the correct lock between third maxillary incisor and maxillary canine tooth, they are always inclined significantly labially.

**Mandibular canines linguoversion** - is the most frequently diagnosed occlusion defect, joining and often being confused with the MA phenomenon. The cause of this condition may be not only MA but also often late exchange and persistent mandibular canines from the first dentition. Here we must point out timely and necessary interceptive orthodontic treatment enabling to the mandibular canine teeth from permanent dentition achieving normal position and locking between the third maxillary incisor and maxillary canine tooth by natural evolution and by the forces of tongue. If this treatment is not performed in time, the danger of mandibular canines linguoversion arises and in connection with narrowing of the interdental space between the third maxillary incisor and maxillary canine tooth the condition may become in a short time of a few weeks orthodontically insoluble. Common consequence of this condition is the penetration of the mandibular canine crown to the hard palate, mostly from the palatal side of maxillary canine tooth - this depends on the location of changes if the MA phenomenon combines possibly with type 2 malocclusion (MAL 2). According to the severity of these changes orovestibular or oronasal fistula may appear. For this reason, please do not ignore linguoversion of mandibular canines, because these traumatic changes can be very painful. The simplest solution of this state (with the exception of an orthodontic treatment) is a **mandibular canine tooth crown amputation** in one or more steps (if treatment of the pulp is required).

Because the trauma of the hard palate arises immediately after full eruption of the mandibular canines, we cannot wait with the treatment. The literature gives a choice – first one is the extraction of mandibular canines because of the trauma of the hard palate. But this treatment leads to unnecessary removal of functional tooth from the dog mouth and the result of this procedure is totally equal to mandibular canine tooth crown amputation.

Clinical diagnosis of Mandibula Angusta phenomenon may seem quite difficult. It is therefore necessary to approach this condition in a systematic manner. Decisive for diagnosis is the frontal view - front view. In this view, comparing the width of the maxilla and mandible we need to use a certain assistant points. I recommend to compare the width of the jaws from the points, where both canine teeth of one jaw enter the gums on the labial side. Necessary is frontal approach, when examining person or helper are comparing the width of both jaws with the closed and again with the slightly open mouth with exposed gums. At a high level of defect the diagnosis is obvious, but I always recommend to perform photographic documentation. Firstly for the opportunity to review the condition later on the computer screen after examination and secondly at lower degree of mandibula angusta or at other complications and possible associated alveolar and skeletal malocclusions, for the opportunity to consult this condition with a specialist. In addition to assessing the width of the jaw as described above, it should also be during the second step assessed as far as the positioning and angle of the mandibular canines is concerned. When
the phenomenon of MA is present, there can be linguoversion at one or both mandibular canines. But if mandibular canine teeth are in the correct lock in interdental space between the third maxillary incisor and maxillary canine tooth and MA is present, the mandibular canine teeth are every time inclined significantly labially. Just in this situation when the mandibular canines are in relatively correct position, then colleagues at veterinary practices, judges at dog shows and owners are tempted to ignore this condition and subsequently to spread this significant heritable defect into the population. In my experience I have to confirm that some specific difficulty in clinical diagnosis of mandibula angusta is leading to its increasing prevalence, so now this condition is present in pure dog breeds perhaps more commonly than the “classic malocclusions” Type 2 and 3.
Malocclusions present with several distinct patterns. Learning to identify these patterns of abnormal skeletal growth and tooth position in a young patient will set the stage to offer proper client counseling, and answer why we should provide therapeutic options for a pain free bite in the developing puppy.

When a patient presents with a malocclusion, it is important to determine if the problem is due to abnormal skeletal growth, malpositioned individual teeth, or both. Abnormal tooth position with normal skeletal development is termed a neutral closure, or a class 1 malocclusion, with a description of the abnormal position of the affected tooth or teeth. Interestingly, when abnormalities in skeletal growth are identified, the maxillae will always provide the dental arch of reference, even in brachycephalic breeds such as Boxers and Pugs. A lower jaw that is shorter than its matching maxillary counterparts will close in a fashion that places the mandibular arch in a position that is distal (caudal) to the respective dentition in the maxillary arch. This is termed a mandibular distoclusion, or class 2 malocclusion (layman’s term is overbite). A full description, with illustrations, of malocclusions can be found on the website of the American Veterinary Dental College (AVDC.org) in the nomenclature section.

The normal maxillary-mandibular relationship in normal occlusion places the maxillary incisors just overlapping the mandibular incisors in a “scissors” bite. The mandibular canine teeth rest evenly and atraumatically in the diastemae between the maxillary 3rd incisors and canine teeth. The maxillary and mandibular premolars interdigitate with each other, with the mandibular 1st premolars positioned as the most rostral in the sequence. The maxillary 4th premolars overlap the buccal aspect of the mandibular 1st molars.

Identifying malocclusions early is the first step in managing the condition to provide the patient with a functional and pain-free bite. Understanding the arrangement of a normal patient’s dentition will serve immensely to recognize malocclusions when they exist. This can be systemically broken down into four questions. 1) Is there a normal overlap and position between the maxillary and mandibular incisal arches? 2) Is there proper engagement of the mandibular canine teeth in the maxillary diastemae between the maxillary 3rd incisors and canine teeth? 3) Is there proper interdigitation between the maxillary and mandibular premolars with the mandibular 1st premolar serving as the first in the sequence? 4) Is there proper overlap between the carnasial teeth (maxillary 4th premolar and the mandibular first molar)? If the answer is “no” to any of the four questions, then
the patient likely has a malocclusion and should be evaluated for the presence of traumatic contacts. Once the sites of traumatic contact are identified, a plan can be instituted to effectively manage the patient’s condition.

Malocclusions will present in several different scenarios. Patients may demonstrate exclusively deciduous dentition, a mixture of deciduous and permanent dentition, or exclusively adult dentition. Any of these three categories may exhibit normal skeletal length and size to the maxillae and mandibles, or patterns of abnormal growth and development. Given the potential combinations and complexity of these cases, it is no surprise that many people prefer to take a “wait and see” approach, hoping that time will allow the problems to sort themselves out.

The fallacy with this approach is that the skeletal and dental development in these patients is occurring rapidly, and there are distinct windows of opportunity to intercept the problems, and manage the condition. Malocclusions rarely resolve on their own accord. Three main reasons exist for managing a malocclusion sooner than later. First, malocclusions may result in traumatic contact of teeth against soft tissue resulting in pain and inflammation. Many puppies will often be found to be face shy, and will resist an oral exam with the pain of their condition. Second, with maloccluding teeth striking and engaging soft tissue of the opposing dental arch, a dental interlock can occur that interferes with proper growth of the involved jaw. And, third, maloccluding deciduous teeth will often crowd the erupting adult dentition, making the condition potentially more severe as time elapses.

Puppies that present with accompanying anatomic skeletal abnormalities such as mandibular distoclusion (class 2 malocclusion) will typically have palatal trauma from both the deciduous mandibular canines as well as the mandibular incisors. The coronal cusps of the mandibular deciduous canine teeth are observed to be striking the palatal attached gingiva, or even palatal mucosa, with accompanying pain and soft tissue trauma. Some of these sites will even develop fistulas, with sinus tracts exiting through the buccal attached gingiva of the maxilla. In these cases interceptive extraction of the offending teeth is indicated immediately. Extreme care must be exercised when extracting these deciduous mandibular canine teeth. Excessive force or lingual placement of the dental elevator may cause trauma to the developing enamel epithelium of the adjacent adult dentition. Focal enamel defects may be visualized in the walls of the enamel once the adult teeth have erupted. Often times proceeding with a surgical extraction will offer better exposure of the root structure and minimize the manipulation required of the dental elevator. Removing the maloccluding deciduous canine teeth will offer immediate relief to the patient. Both the incisors and canine teeth can engage into the palatal tissues and create a dental interlock, effectively preventing any rostral growth potential of the lower jaw. It is important to understand that extracting these teeth will not directly stimulate the jaw to grow, but will allow it the opportunity to grow to its genetic potential, whatever that may be. Again, with the long, fragile nature of the roots of these deciduous teeth, surgical extractions will often allow the least invasive approach with the dental elevators.

Final assessment of a malocclusion will not necessarily be complete until a patient has reached skeletal maturity and has completed the eruption of its adult dentition. Since puppies will erupt both a temporary and permanent dentition, it is well worth informing the owner of the likely need to manage malocclusions with both sets of teeth. Early management of problems in deciduous dentition can often dampen the severity of a malocclusion within the permanent dentition, and may allow for simpler and less invasive definitive treatment options in the maturing patient. In milder cases of linguoversion (base narrow) of the mandibular canine teeth, coaxing the dog to chew and bite down on an appropriately sized ball toy can place appropriate forces on the teeth to move them labially.
Adolescents that are erupting permanent mandibular canine teeth in a mild to moderate state of linguoversion (base narrow) may be candidates for wedge gingivoplasties at the maxillary 3rd incisor-canine tooth diastemae with accompanying application of composite cap extensions of the partially erupted mandibular canine teeth. These two techniques are often paired to create an intermittent orthodontic force to move the mandibular canine teeth labially by 1-3mm. Application of composite cap extensions to the mandibular canine teeth effectively changes the contact points of the canine teeth against the maxillae. When the patient closes his or her mouth, the extensions engage the lateral aspect of the diastemae and serve to move the teeth labially/buccally over time. Creating an angled wedge incision within each maxillary diastema effectively creates a simple incline plane to accept the composite cap extensions, and enhances the success of the labial/buccal movement of each tooth. The success of these techniques will depend on careful case selection. Mandibular canine teeth that are severely base narrow will not respond to this technique. Bonding a full incline plane or expansion appliance to the maxillary dentition to orthodontically move the mandibular canine teeth would then be a better choice. It is also important to evaluate the width of each diastema between the maxillary 3rd incisors and canine teeth. If the space is too narrow to accept the cusp of the adult mandibular canine tooth, then alternate treatment options may be required.

There will be some cases of malocclusion that are not amenable to orthodontic movement at all. Class 2 malocclusions (mandibular distoclusion) may exhibit traumatic palatal contact from the adult mandibular canine teeth directly on the palatal aspects of the adult maxillary canine teeth. At the very least, these situations will be acutely painful to the patient and risk tremendous damage to the periodontal support of the maxillary canine teeth. At worst, full thickness penetration through the palatal bone with bilateral oronasal fistulas can occur. The preferred treatment option in this case is to crown reduce both mandibular canine teeth and perform vital pulpotomies, or possibly root canal therapy, before any long term damage has occurred. The other, less desirable, treatment option would be to surgically extract both mandibular canine teeth to eliminate the palatal trauma. Once the mandibular canine teeth have been treated, and traumatic palatal contact eliminated, it is always important to reevaluate the patient to be sure the mandibular incisors are not secondarily causing palatal trauma. This would not necessarily be expected in cases of neutroclusion (class 1 malocclusion), but very well could occur in cases of mandibular distoclusion (class 2 malocclusion).

In cases where the mandibular incisors are making mild to moderate traumatic contact against the palatal tissues, an easy option is to shorten and reshape (odontoplasty) the incisal edges of the teeth without exposing the pulp chambers. Because the enamel surface is removed, and the dentinal tubules invaded with this procedure, a bonded sealant is applied to the reduced surfaces prior to recovering the patient from anesthesia. If the height reduction requires invasion into the pulp chambers of the teeth, vital pulp therapy would be required to save the teeth. The other option would be to simply extract the teeth.

**References and suggested reading**

1. AVDC.org American Veterinary Dental College website. Navigate to Nomenclature, select Classification of Dental Occlusion in Dogs.


Malocclusions present with several distinct patterns. Learning to identify these patterns of abnormal skeletal growth and tooth position in a young patient will set the stage to offer proper client counseling, and answer why we should provide therapeutic options for a pain free bite in the developing puppy.

When a patient presents with a malocclusion, it is important to determine if the problem is due to abnormal skeletal growth, malpositioned individual teeth, or both. Abnormal tooth position with normal skeletal development is termed a neutroclusion, or a class 1 malocclusion, with a description of the abnormal position of the affected tooth or teeth. Interestingly, when abnormalities in skeletal growth are identified, the maxillae will always provide the dental arch of reference, even in bacchcephalic breeds such as Boxers and Pugs. A lower jaw that is longer than its matching maxillary counterparts will close in a fashion that places the mandibular arch in a position that is mesial (or rostral) to the respective dentition in the maxillary arch. This is termed a mandibular mesioclusion, or class 3 malocclusion (layman’s term is underbite). A full description with illustrations of these malocclusions can be found on the website of the American Veterinary Dental College (AVDC.org) in the nomenclature section.

The normal maxillary-mandibular relationship in normal occlusion places the maxillary incisors just overlapping the mandibular incisors in a “scissors” bite. The mandibular canine teeth rest evenly and atraumatically in the diastemae between the maxillary 3rd incisors and canine teeth. The maxillary and mandibular premolars interdigitate with each other, with the mandibular 1st premolars positioned as the most rostral in the sequence. The maxillary 4th premolars overlap the buccal aspect of the mandibular 1st molars.

Identifying malocclusions early is the first step in managing the condition to provide the patient with a functional and pain-free bite. Understanding the arrangement of a normal patient’s dentition will serve immensely to recognize malocclusions when they exist. This can be systemically broken down into four questions. 1) Is there a normal overlap and position between the maxillary and mandibular incisal arches? 2) Is there proper engagement of the mandibular canine teeth in the maxillary diastemae between the maxillary 3rd incisors and canine teeth? 3) Is there proper interdigitation between the maxillary and mandibular premolars with the mandibular 1st premolar serving as the first in the sequence? 4) Is there proper overlap between the carnasial teeth (maxillary 4th premolar and the mandibular first molar)? If the answer is “no” to any of the four questions, then
the patient likely has a malocclusion and should be evaluated for the presence of traumatic contacts. Once the sites of traumatic contact are identified, a plan can be instituted to effectively manage the patient’s condition.

Malocclusions will present in several different scenarios. Patients may demonstrate exclusively deciduous dentition, a mixture of deciduous and permanent dentition, or exclusively adult dentition. Any of these three categories may exhibit normal skeletal length and size to the maxillae and mandibles, or patterns of abnormal growth and development. Given the potential combinations and complexity of these cases, it is no surprise that many people prefer to take a “wait and see” approach, hoping that time will allow the problems to sort themselves out.

The fallacy with this approach is that the skeletal and dental development in these patients is occurring rapidly, and there are distinct windows of opportunity to intercept the problems, and manage the condition. Malocclusions rarely resolve on their own accord. Three main reasons exist for managing a malocclusion sooner than later. First, malocclusions result in traumatic contact of teeth against soft or hard tissue resulting in pain and inflammation. Many puppies will often be found to be face shy, and will resist an oral exam with the pain of their condition. Second, with maloccluding teeth striking and engaging soft tissue of the opposing dental arch, a dental interlock can occur that interferes with proper growth of the involved jaw. And, third, maloccluding deciduous teeth will often crowd the erupting adult dentition, making the condition potentially more severe as time elapses.

Young puppies presenting with cases of mandibular mesioclusion (class 3 malocclusion) should be evaluated for traumatic contact on the floor of the mouth from the maxillary incisors, and for traumatic contact of the mandibular canine teeth against the maxillary 2nd or 3rd incisors. If traumatic contact is identified, the offending deciduous teeth should be extracted. Sometimes, with these patterns of malocclusion, the deciduous maxillary incisors are too small to make traumatic contact with the opposing oral mucosa. Depending on the length discrepancy between the mandibles and maxillae, the mandibular canine teeth may miss the maxillary incisors completely.

Adolescents exhibiting mandibular mesioclusion with erupting permanent teeth may require selective extractions of maxillary 3rd and possibly 2nd incisor teeth to accommodate the position of the larger and structurally more significant mandibular canine teeth. Untreated cases can go on to develop marked displacement and mesioversion of the involved incisors, canine teeth, or both. Chronic tooth on tooth contact has the potential to create marked abrasion patterns on the surfaces of the teeth. In some cases, chronic concussive trauma from tooth on tooth contact can produce an irreversible pulpitis and ultimately a non-vital tooth.

In cases where the maxillary incisors are making mild to moderate traumatic contact against the floor of the mouth or lingual aspects of the mandibular canine teeth, another option is to shorten and reshape (odontoplasty) the incisal edges of the teeth without exposing the pulp chamber of the tooth. Because the enamel surface is removed, and the dentinal tubules invaded with this procedure, a bonded sealant is applied to the reduced surfaces prior to recovering the patient from anesthesia. If the height reduction requires invasion into the pulp chambers of the teeth, vital pulp therapy would be required to save the teeth. The other option would be to simply extract the teeth. Chronic contact of the maxillary incisors against the lingual dental papillae of the mandibular incisors can produce severe periodontal pathology and root resorption.

Final assessment of a malocclusion will not necessarily be complete until a patient has reached skeletal maturity and has completed the eruption of its adult dentition. Since puppies will erupt both a temporary and permanent dentition, it is well worth informing the
owner of the likely need to manage malocclusions with both sets of teeth. Early management of problems in deciduous dentition can often dampen the severity of a malocclusion within the permanent dentition, and may allow for simpler and less invasive definitive treatment options in the maturing patient.

References and suggested reading

1. AVDC.org American Veterinary Dental College website. Navigate to Nomenclature, select Classification of Dental Occlusion in Dogs.
The use of Temporary Anchorage Devices (TAD) in canine orthodontics is not common, though it has been used in people for many years.

TAD is an implant used in orthodontics. It is inserted into bone and requires no precutting of gingiva. Placement is usually much quicker, and takes typically just a few seconds or minutes. TAD eliminates the risk of moving anchor teeth.

There are many different systems on the market. Many systems are complex and require a wide stock to meet different clinical situations. The author prefers Imtec Ortho Implant system because of its simplicity and user friendliness. The implants come in three different lengths, 6 mm, 8 mm and 10 mm. The implants are drill-free and self-tapping. The screws are thread-forming which means it compresses bone in and around the screw threads during advancement. A customized screwdriver is required to insert the implant.

It is important to place the implant perpendicular to the bone and in locations with a minimum of 0.5-1.0 mm of bone around the circumference of it. It can be placed as close as 0.5 mm from the PDL without causing any damage to the tooth.

The implant can be loaded immediately after placement.

The implant is well tolerated by canine patient. Gingival reaction, which requires special care, is rare, but if placed through mucosa it might cause significant local inflammation. Daily home care is important to minimize inflammation.
Use of crown extensions to correct linguoverted permanent mandibular canine teeth

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Crown extensions with bis-acryl chemical-cured composite can be used to correct mildly and occasionally severely linguoverted mandibular canines as a sole treatment, even when associated with Class 2 malocclusions. The presentation demonstrates how to design a proper extension and explains the secret how to succeed and how to avoid pitfalls by this approach.

Traditionally, orthodontic correction for linguoverted mandibular canines in dogs has been treated with inclined planes (IP) or crown reduction followed by vital pulp therapy. Some veterinary dentist have used composite or bis-acrylate crown extensions to correct this malocclusion for many years. There are limited publications in the veterinary literature about this technique, also referred to as inclined capping. The author has used the technique successfully in more than 70 patients, with either unilateral or bilateral linguoverted permanent mandibular canines. Installation of crown extensions is usually time saving, but still technically demanding, compare to bis-acrylic bite-wing incline plane appliance. The comfort for the animal seems to be significantly better with crown extensions than with incline planes. There is never secondary palatitis and it is significantly less gingival and mucosal inflammation. Nevertheless, gingival compression in the diastema (between the maxillary third incisors and cuspids) may lead to gingivitis at the initial stages when treating severely maloccluded canines.

A potential advantage with this technique compared to IP, is that it does not have any negative impact on maxillary development when applied in young patient.

Linguoverted or displaced mandibular canines impinging upon the palate are uncomfortable and may cause different degrees of ulceration and damage to the palate. In severe cases, impinging canines can even advance through the palate and enter the nasal cavity. Less dramatic cases, but still severe, may cause deep pocket formation of more than 10 millimeter along the distal, palatal or mesial aspect of the maxillary canines. Delayed treatment may lead to more severe complication, such as deep pocket formation, oronasal fistula, non-vital teeth due to chronic pressure, attrition of interacting teeth, incomplete eruption of the affected tooth/teeth with secondary periodontal pockets, and last, but not least, a more complicated and prolonged treatment if an orthodontic movement is chosen to solve the problem. When diagnosed early, the eruptive forces of the tooth can be used to guide it into the target location. Early treatment is favorable due to less complication and better outcome. The author prefer to see the patients at the age of 5-6 months if it is obvious that the patient have a problem with malocclusion.
After initial consultation, which includes a thorough physical exam, preoperative photos, radiographs and bite registration, the patient is placed in dorsal decumbency under general anesthesia. Involved teeth must be cleaned and polished with oil-free pumice or universal rubber polisher. Both canines, regardless if there is a unilateral or bilateral problem, must be treated to obtain symmetry by occlusion. The enamel is conditioned with phosphoric acid as required by the manufacturer of the bonding agent being used. Correct bonding technique is a critical step to avoid frustration due to debonding. It is important to read manufacturers instruction for each product carefully.

While some clinicians prefer composite for the crown extension, the author prefers bis-acrylate (3M Espe Protemp Garant). It is helpful to choose a darker shade, like B3, to distinguish the material from the tooth structure. Due to the viscous property of the material, it must be placed on the tooth in several increments. For optimal bonding it should be placed around the circumference of the crown starting close to the gingival margin to mid-crown, depending on how much the tooth has erupted, then successfully build up in a coronal direction. The amount of material is dependent on the initial position of the tooth. Slightly closing the mouth allows the clinician to appreciate where to put more bis-acrylate. Initially it must be sufficient so the tip of the extended crown reach the buccal side of the maxillary diastema. Bis-acrylate products consists of a separate catalyst and a base which are brought together via a self-mixing tip attached to a delivery gun. When the two substances are mixed they set by an exothermic polymerization reaction. After one minute, it is hard, but the entire polymerization takes five minutes to finish. The amount of heat depends on how much material is being applied. The temperature reached in a relatively small amount of bis-acryl, about 10 mm diameter, is 45°C, (113°F), and in a larger amount, about 20 - 25 mm in diameter, (which is probably larger than what is usually applied in one setting in a clinical situation), is 63°C, (145°F). (Authors observation). The generated heat reaches its peak after 120 – 150 seconds and last for 60-90 additional seconds before temperature decreases. (Author’s observation).

After sufficient amount of bis-acrylate has been placed on right and left mandibular canine tooth, the process of shaping the extension into a functional occlusion begins. An acrylic bur on a straight handpiece can be used, but the author prefer to use long friction grip (FG) diamond burs on a high-speed handpiece. Any long coarse or extra coarse burs (blue, green or black coded), modified shoulder, round end taper or flame can be used. Many veterinary dental units does not have water supply to their low speed handpiece, and without water the shaping procedure will generate a lot of hazardous fine acrylic dust. This is better controlled when water-cooled.

When it is time to check the occlusion more accurately, it can be done in several ways to overcome the problem with the endotracheal tube. In dogs which miss a premolar tooth or in dogs where the distance between the upper and lower first and second premolars is quite wide, there is often enough space to enter the tube out here. Press the mouth gently together and make small pencil marks where the extension needs to be modified, either by removing more substance with the bur or in even add more bis-acryl if needed. The occlusion can also be checked either by complete extubation or the connector to a shortened endotracheal tube can be disconnected. While the cuff is deflated, the tube can be pushed further down the trachea in order to be able to close the mouth.

Ideally, the crown extension should fit without retention between the third incisor and the cuspid in the diastema. If the diastema is narrow it can be widened by applying a thicker layer of bis-acryl to the extended crown, but the extension may also break when the patient try to close it’s mouth.

The extension needs to be adjusted to meet the specific problem of the patient. Breed and age is very important. If the patient is less than six-months-old, the canines are very
mobile and perhaps not even fully erupted. Mild linguoverted canines do not need as much support as more severely affected canines. Bull terriers, Pit bulls, Staffordshire bull terriers and similar breeds need stronger construction than other types of dogs. The author will not recommend this kind of treatment in an adult dog of any of the breeds mentioned above.

Using crown extensions to correct severely affected Class 2 malocclusion presents certain challenges. It is important to start with young patients, preferable before the canines are fully erupted. The third incisors require extraction, in order to move the mandibular canines rostrally. The mandibular canines usually need massive build-up to be able to move toward the diastema. To achieve this, a 0.3 mm stainless steel surgical wire is twisted around each canine tooth and then bent in the direction of the diastema. This provides reinforcement and works like a skeleton in the crown extension. In some clinical conditions the crown extension can be combined with an inclined plane. This allows either one of the installations not to be too massive and it minimize the chance of failure. As soon as the mandibular canines approach the diastema, typically after 2-3 weeks, the inclined plane can be removed and the height of the extension can be reduced. Avoid “shoulders” of composite or bis-acryl at the apical part of the extension as this will collect hair and debris and cause gingivitis if it contacts gingiva. The crown extension should be smooth and polished, and match the natural anatomical appearance as much as possible, regardless of being massive or not. The smoother the surface is, the less build up of plaque and better for the patient.

The owner must be given clear instructions to remove all toys, feed only regular dog food (dry or wet), but no raw food if it contains larger parts, no chews, no playing with other dogs, leash walking only, prevent the dog from biting on cage doors or similar objects and absolutely no “Tug of war”!

If the crown extensions cause gingivitis due to tight contact with gingiva in the diastema, it should be treated with chlorhexidine rinse or gel twice daily and NSAID’s. It usually resolves in 1-2 weeks.

The first follow up should be within 2 weeks post-installation. In most cases the patient is then able to close its mouth completely. The extension should be reduced just enough to create sufficient retention and prevent relapse. If it is obvious that the tooth has sufficient retention by itself, the clinician might consider to remove the extension, but in most cases some extension is needed for retention purposes for another 4 weeks.

In most cases a full treatment includes 3 anesthetic episodes; installation, recheck + reduction and finally removal. More advanced cases might need several adjustments, before final result is achieved.

Correct removal technique is very important to avoid damaging tooth structures. Use only instrumentation intended for orthodontics. If the bis-acryl was placed as described above, it bonds really well to the tooth. Ordinary pliers have a broad base and is likely to damage the tooth. Tooth structures might come off and even pulp exposure can occur. The author prefers bracket removing pliers with sharp edges. They can cut precisely where the clinician intend to cut and they stay sharp for years. Gross substance is removed with pliers, the rest can be removed by polishing discs.

Remaining teeth should have a professional dental cleaning as plaque and calculus tend to build up rapidly when the patient is restricted from chewing. Postoperative radiographs and clinical photos are obtained.

A follow-up visit should be planned after 6 months, preferably with radiographs, to confirm normal pulp development and to look for any sign of tooth resorption and other abnormalities.
In this presentation, we will discuss the discovery of MTA – mineral trioxide aggregate, as well as its development, and uses. Illustrations showing MTA’s use will be presented and evaluated, and potential future applications discussed. We will also discuss possible alternative formulations for MTA.
Endodontic therapy is becoming increasingly common in veterinary medicine. It is a very technically demanding procedure, wrought with potential pitfalls. Most improper/failed endodontic therapies will not result in outward clinical signs, however the patient still suffers. Therefore, perfect performance and routine recheck radiographs are critical to maintain patient health. Root canal therapy has three ordered components: access, cleaning and shaping, and obturation. They are separate steps, but each one builds upon the prior. This presentation will discuss common complications which occur during the procedure, keys to their avoidance, and correction when they occur.

**Step 1: Access**

It has been stated that failure to achieve proper access is one of the most common complicating factors for veterinarians. Therefore, careful access is crucial to proper endodontic therapy.

**Improper access placement:** The goal is straight line access to the apex; therefore, the fracture site is not a good access site except for some incisor teeth and occasionally the maxillary canines in cats. When used as access, ledging and transportation commonly occur.

To avoid this error, make sure to follow the correct placement.

If you determine that your access is incorrect during the procedure, there are several options for repair. If the access is only slightly off, consider enlarging the access in the direction of the ideal. If it is significantly incorrect, make a new access site.

**Improper access size:** The law of tooth conservation dictates a small hole to retain as much tooth strength as possible. However, insufficient access will bind the file in the coronal area, preventing it from following the canal curves or irregularities. This can result in errors of instrumentation such as ledging, gouging, or zipping (see below). In addition, the master file or cone will bind in the access, giving the erroneous feeling that the canal is completely cleaned, leading to short fills.

Prudent practitioners avoid this by approximating the master file based on pre-operative radiographs. Utilizing the anticipated master file and working length create the access.
slightly larger than the diameter of the calculated master file at the access point.

The repair for an undersized access is to enlarge the site to the proper size as soon as the error is realized. An overlarge access cannot be fixed. However, if a significant amount of crown has been removed, thus weakening the tooth, a crown is strongly recommended.

**Furcational perforation:** Overzealous use of a bur during access preparation can result in the perforation of the floor of the pulp chamber in the furcation of the tooth. This often offers a poor prognosis. In fact, more coronal perforations have lower prognoses.

Perforations can be avoided by approximating the distance to the floor of the tooth and advancing very slowly in the apical direction. Stop regularly during the access preparation and use a pathfinder or explorer to feel for the pulp chamber. Once the pulp chamber is exposed, there is no need to proceed apically.

If perforation occurs, the first step is to repair the defect. Prior to repair, the endodontic system should be protected against contamination with medicants and restoratives with paper or gutta percha points. Next, the defect is prepared to accept the barrier/restorative if necessary. This process is ideally performed with ultrasonic instruments. However, as access perforations are generally caused with a bur, further preparation is generally unnecessary.

After preparation, hemostasis is achieved with cotton pellets or paper points. If this is ineffective, calcium hydroxide can be placed in the defect and allowed to sit for 4-5 minutes. Following this, it should be rinsed with dilute sodium hypochlorite. Two to three applications is generally sufficient for hemostats. If hemostasis is still not achieved, consider placing the calcium hydroxide and temporarily filling for 2 weeks prior to continuing endodontic therapy. Another valid option at this point is extraction or hemisection. Other options for this step are collagen, calcium sulfate, freeze-dried bone, and MTA. Other hemostatic agents (such as ferric sulfate) are not recommended.

Following hemostasis, a barrier must be placed to protect the tissues adjacent to the perforation. There are many options for this step including the resorbable barriers of collagen and calcium citrate. These products require the subsequent placement of a non-resorbable restorative. MTA is non-resorbable and has excellent biocompatibility. Therefore is the current restorative and barrier material of choice.

After the defect is repaired, the canal(s) can be instrumented and obturated normally.

**Step 2: Cleaning and shaping**

**Improper working length:** Working length is approximated by measuring the distance on the pre-operative radiographs and gently introducing a small file to the apex and then exposing a dental radiograph. After the depth is determined, the endodontic stop is moved to the access point, the file removed and the distance measured. Once determined, all files are armed with endostops at the correct point and then files used to the working length.

If the practitioner does not determine working length correctly, the entire process of instrumentation will be performed erroneously. In general, a working length error will be short of the true apical contracture, leading to underextension/underfill. In cases of a significantly diseased apex, the file may be extended through the apex. This will result in overextension/filling if not corrected.

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*a* Collacote: Sulger dental. Carlesbad, CA.

*b* Capset: Lifecore Biomedical. Chaska MN.
This error can be avoided by:

1. Approximating the working length by studying the pre-operative radiograph.
2. Gently advancing the working length file to the approximated apex.
3. Properly exposing and interpreting the working length radiograph.
4. Properly placing the endostop, measuring, and marking all subsequent files.
5. Exposing regular radiographs during the shaping procedure to ensure that work continues to the entire canal length.

If the working length was underestimated, reestablish the working length as soon as possible, remark all the files appropriately, and utilize the new working length.

If it was overestimated, hemorrhage will generally result as the file will traumatize the periapical tissues. This will often be evidenced by fresh hemorrhage from the apex. If this occurs, the first step is to control hemorrhage with paper points.

There are two options for sealing the apex.

Backup technique

Re-establish the working length radiographically, 1-mm short of the apex. Then carefully “overfile” the apex creating a “stop” at that point and obturate normally. In these cases, an open apex has been created, so caution must be taken with irrigation to avoid a hypochlorite accident. In addition, consider utilizing a sealer which is less inflammatory as overfill is a possibility. This technique has been clinically successful, but remains controversial.

MTA seal technique

This is the most proper technique for obtaining a quality apical seal. It consists of finishing the standard endodontic therapy and then placing a “plug” of MTA at the apex. The product is mixed according to package directions and placed to the apex. This can be via a customized needle or an endodontic trowel. Ideally, this is allowed to set prior to filling. This is accomplished by placement of a temporary filling material and performing obturation approximately two weeks later. However, the additional anesthesia is a concern, and so many veterinary dentists carefully obturate during the same anesthetic event.

Once obturation has been perfected, there are two options:

1. Give the case the “benefit of the doubt” and recheck in 6 months.
2. Perform surgical endodontics.

If properly obturated, these cases still have good prognosis and thus surgical endodontics should be reserved for future visits if failure occurs. Other authors may argue for immediate surgical endodontics or even extraction of these teeth. These approaches, while more invasive, are more definitive. Therefore, the client should be informed of the complication. For strategic teeth however, the risk: benefit ratio is still on the side of standard root canal therapy.

Ledging, zipping, and gouging: Apical filing must be performed in a rotary manner with a feather light touch. Therefore, H-files are not recommended at the apex. Ledging or gouging the canal is common when too much apical force is applied.

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* West Per repair instrument: Analytic Endodontics. Orange, CA.
This can be avoided by utilizing the correct instruments with a careful touch at the apex. Furthermore, identifying and respecting the three dimensional character of the endodontic system will help minimize the risks. Finally, exposing regular, intraoperative radiographs will help avoid this issue.

If ledging occurs, return to a small file size which is significantly pre-bent (almost 90 degrees at the tip), and carefully introduce it to the apex. This may require gentle turning at the ledge to find the canal. Enlarging the access to allow more freedom of movement for the files may also be beneficial. Once the apex is achieved and confirmed radiographically, the file is carefully moved up and down in very small strokes (1-2 mm). Always make sure to stay apical to the ledge. Once the small file is moving freely in the canal, longer strokes are utilized to smooth the ledge. Utilizing “anti-curvature” filing will help to remove the ledge. Finally, slowly and very carefully increase file sizes until instrumentation is complete. Exposing regular intraoperative radiographs will help ensure that the defect is not being recreated.

**Incomplete instrumentation:** The operator should have a rough idea of the master cone size based on the pre-operative radiograph. Two additional indications of complete filing are clean white filings and file binding at the apex.\(^5\) Most texts recommend filing to the third file size to bind at the apex.\(^6\) The master point should reach the apex and fit snugly, ideally creating “apical tug back”.

Incomplete instrumentation can be avoided by exposing a radiograph to assure that the point properly fills the apex. More than one view is ideal to help ensure a complete three dimensional fill.

If the master point does not fill the apex, return to instrumenting and continue until the fill is proper.

**File separation:**\(^6,7\) There are two main causes of file separation. The first is using old, damaged/weak files. The other is binding the file in the canal. If the file is turned excessively, binding and file separation can occur. File binding generally occurs when significant rotary motion (reaming) is performed with excessive apical pressure. Additionally, using H files in a reaming motion will rapidly result in canal binding. Once separation has occurred, endodontic therapy is made exceedingly challenging.

Always ensure the type of file, and utilize it in the correct manner. Always use instruments with a feather touch and avoid overzealous rotation and apical pressure. When working on a constricted canal, use a “watch winding technique” and generous amounts of lubricant.

It is exceedingly rare for files to suffer from manufacturer’s defects, which means new files are very reliable. Oftentimes however, after just a few uses (even on the same patient), strain will start affect the file. This is especially true if the files are “prebent”. Files should be replaced for each patient, or at least routinely. If a practitioner is reusing files (which is somewhat understandable especially with the more expensive “veterinary length” files) they should be carefully cleaned and inspected (and ideally sterilized) between patients. An area of smoothness in the fluted area is indicative of a weak area and the file should be discarded.

If file separation occurs, there are several options for resolution:

1. If possible, remove the fractured file. If the file was fractured near or at the access (which is where “lightspeed” files are designed to break), removal should be fairly straightforward. If the fracture occurred deep in the canal, removal will be difficult to impossible. Filing around the file can as well as enlarging the access can be ben-
eficial in some cases. Other helpful instruments include an ultrasonic endodontic tip to loosen the segment and magnetized instruments for retrieval.

2. If the instrument cannot be removed, attempt to file around the obstruction and obtain a good seal. If this is possible, the prognosis should not be significantly decreased. The canal should be especially well lavaged with bleach to disinfect the file and canal. The canal is then cleaned and obturated normally. If obturation is adequate, a fair to good prognosis is still likely.

3. If the obstruction cannot be removed or negotiated, a surgical root canal or extraction should be performed.

Hypochlorite accidents: Sodium hypochlorite is highly corrosive and should never be forced periapical. Irrigation should be performed with a side exit endodontic needle without excessive pressure. Extreme care must be taken in the presence of diseased or barely complete apicies as they are more porous than mature/healthy ones.

The apex is ideally opened to at least an ISO size 25 file prior to irrigation to avoid forcing the irrigant peri-apically. It is critical that the irrigation needle not bind in the canal.

If an accident occurs, it is usually evidenced by a sudden change in the anesthetic plane of the patient during or right after irrigation. This typically occurs in spite of good surgical anesthesia including regional nerve blocks. This is evidence of the significant pain and inflammation created by the extrusion of the irrigant. Furthermore, immediate apical hemorrhage is a common consequence.

Treatment includes encouraging drainage from the root canal with suction and lavageing the canal with sterile saline to remove and dilute the bleach solution. In human dentistry, continued drainage is often allowed by leaving the tooth open for a short time if drainage is persistent. This is controversial in veterinary dentistry due to the anesthetic requirements. However, in cases with significant extrusion of solution, this should be considered.

The owner should be warned to expect some post-operative swelling and that follow-up care/monitoring is critical. In addition, pain medication and anti-inflammatories (NSAIDs or corticosteroids) are indicated and antibiotics should be considered. Finally, cold compresses should be performed to decrease pain and swelling.

Step 3: Obturation

A complete, homogeneous fill of the entire canal without voids is critical for endodontic success. The most critical area of the fill is the apex, but any defect can lead to failure.

Underfill

With cold gutta percha techniques, underfill generally occurs due to an inappropriate mastercone size. This error can therefore typically be avoided by careful radiographic study of the master cone prior to obturation. If utilizing softened gutta percha, underfill can occur secondary to an insufficient canal width to accept the cannula, or to inadequate vertical condensation.

Correction of cold gutta percha errors depends on the position of the defect(s).

If the post-operative radiograph reveals a less than ideal apical fill, the cone should be removed and replaced with the appropriate file. If the point stopped short, it should be replaced with one smaller size. If it does not fill the apex, one size larger should be selected. If obturation of the apex is not optimal after a few attempts, instrumentation should be repeated. If the apical seal is radiographically adequate with coronal voids, lateral condensation should be performed to complete the obturation. If this step is ineffective, the
obturation should be removed and the canal reobturated. If obturation is not optimal after a few attempts, consider reshaping the canal to allow a proper fill.

For softened systems, attempt further condensation. If this is ineffective, remove the material and repeat obturation.

**Removal of gutta percha**

This removal is facilitated by softening the core filling material. This can be performed via heat (e.g. touch and heat system), ultrasonic instrumentation, rotary files, or chemicals. Chemical softening with chloroform is the most common and effective method for this, but it is highly inflammatory. Other options include xylol, turpentine, eucalyptol, and orange oil. Chemical removal is generally accomplished by placing the agent on the gutta percha and carefully “pecking” away the softened material. Once this is accomplished, the residual GP, sealer cement, solvent, and smear layer is removed with paper points (wicking). This (Note that these same methods can be utilized for retreatment, see below)

**Overfill/overextension**

This is a fairly common complication in cases of a diseased, damaged, or barely mature apex. It can also occur with overzealous vertical condensation. If the apex is immature or diseased, consider utilizing a less irritating sealer cement (such as CaOH or glass iomoer). These complications can be avoided by a few meticulous steps which include: careful apical preparation, selecting a proper master cone, and not placing too much apical pressure when condensing.

If overextension occurs with solid gutta percha, attempt to carefully remove the point. In cases where the point cannot be removed and/or there is significant cement extrusion there are several options:

1. Obturate and restore normally and monitor. This author has seen minimal complications in these cases, provided the extrusion was not severe.
2. Perform surgical endodontics. Make sure to thoroughly debride and lavage the extruded cement and gutta percha from the periapical area.
3. Extract the tooth. Again, make sure to thoroughly debride and lavage the extruded cement and gutta percha from the periapical area.

**Treatment of failed standard endodontic therapy**

There are numerous causes of failure of standard root canal therapy, but when properly performed it has an excellent prognosis. Avoid failures by meticulous cleaning and shaping, adequate disinfection, and perfect obturation and restoration.

If obturation of the standard root canal therapy is radiographically inadequate, reinstrumentation and obturation is performed (retreatment). If the obturation appears radiographically sufficient, this can be attempted, but success is much less likely. The options for well performed initial therapy that fails are surgical endodontic therapy or extraction.

**References**


Tooth anatomy

Teeth are roughly broken up into three layers: enamel, dentin, and pulp.

The innermost layer is the endodontic system (root canal or pulp). It contains the nerves, blood vessels, and connective tissue which supply and nourish the tooth during life. The blood and nervous supply enters the tooth through the very bottom or apex of the root.

The outer layer of the tooth crown is enamel, which is an inorganic substance. It is virtually all (97%) calcium and phosphorus and is the hardest substance in the body. Enamel has no nervous or circulatory system. It is applied in a very thin layer (less than 1 mm thick in veterinary patients) over the tooth surface during development by a cell layer called ameloblasts. Once eruption has occurred, enamel cannot be replaced or repaired.

The central layer, which is the vast majority of the tooth structure in mature patients, is dentin. Dentin has roughly the same mineral content as bone. Dentin is a somewhat living structure which has a nervous supply and can occur can respond to stresses. Running at right angles to the root canal all the way around the tooth from the root canal out to the enamel are dentinal tubules. Each one of these dentinal tubules contains an odontoblastic process, which is basically a nervous supply; however they are only sensory and can only report changes as pain. There are approximately 50,000 dentinal tubules per mm² coronal dentin. Therefore, a 1 cm area of enamel loss will expose 3-4 million odontoblasts!

Response to damage

Exposure of the dentinal tubules will lead to much quicker dentinal fluid flow out through these dentinal tubules via the capillary effect. This increase in fluid flow deforms the A-delta C-delta fibers and thus will be perceived by the patient as pain. Anything that will change the flow rate will cause the nerves to fire and result in pain (sensitivity). This includes heat, cold, and desiccation. The sensitivity is actually a sign of low grade pulp inflammation known as pulpitis.

In addition to the sensitivity produced by the exposure of the dentinal tubules, there is a possibility of ingress of bacteria into the root canal system. In some cases this can result in endodontic infection and subsequent abscessation. This occasionally can be seen clinically as a swelling or draining tract, but is generally subclinical and therefore undiagnosed. The
only way to diagnose this infection is via dental radiographs. Once exposure has occurred, material will accumulate on the surface which can mineralize and block the tubules (Smear Layer). In addition, the tooth will sense the disruption of its normal protection and will attempt to shield itself from the harmful invaders of the oral environment as well as decrease the patient’s pain. This will take the form of creating either tertiary or sclerotic dentin. Eventually (as long as the causative problem is not allowed to progress), this may result in the end of sensitivity. However, this process is lengthy (likely months) and the patient is painful and susceptible to infection during this time.

**Indications for restorations**

*Uncomplicated Crown Fractures*: These are very common in large breed dogs. They occur when a piece of the crown is broken off, which exposes the dentin but not the pulp. Occasionally, these teeth can become infected through the dentinal tubules. Again, this infection will go undiagnosed without dental radiology. However, teeth with no to small pulpal exposures tend to be the ones with clinical abscessation.

*Caries*: True bacterial caries are rare in dogs and almost unheard of in cats. They are most common on the occlusal surface of the upper first molars, but can be seen on any tooth. In addition, the most common breed is a German Shepherd dog. Early lesions can mimic wear, and are best diagnosed by tactile feel of the defect with a sharp explorer. If it is sticky, like wax, it is likely a caries lesion. These lesions can progress into the endodontic system resulting in pain and infection.

*Enamel Hypocalcification (EH)*: Hypocalcification results from disruption of the normal enamel development. Ameloblasts are very sensitive and minor injuries can result in enamel malformation. Areas of enamel hypocalcification will generally appear stained a tan to dark brown (rarely black) color, and may appear pitted and rough. The tooth surface is hard however, as opposed to the soft/sticky surface of a caries lesion. The areas of weakened enamel are easily exfoliated which will expose the underlying dentin, resulting in staining. Dentin exposure will result in significant discomfort for the patient (see uncomplicated crown fractures above). The roughness of the teeth will also result in increased plaque and calculus retention, which in turn leads to early onset of periodontal disease.

**Therapy**

*Diagnosis*: First, perform a thorough visual exam to determine the presence of pulp exposure or other extensive damage. Finally, expose a dental radiograph to rule out endodontic disease. If there is radiographic evidence of endodontic disease root canal therapy or extraction is indicated.

*Tooth Preparation*: Scale and polish the surface of the tooth to be treated. Make sure to use fluoride free pumice for polishing to avoid interfering with future acid etching.

If treating a small uncomplicated crown fracture, no actual restoration will be placed. Therefore smooth the rough edges with a white stone or fine diamond bur. This can be followed with sanding discs if necessary.

In cases where a restoration will be placed, it is recommended to use a coarse diamond or carbide bur for the preparation. This will leave a rough surface and increase bond strength. Furthermore, all non-occlusal edges should be beveled. This will make a more gradual transition of color as well as increase the amount of enamel for bonding.

For EH cases, remove all weakened diseased enamel with a coarse diamond bur and bevel the edges
For caries cases remove all carious dentin as well as extend the prep into area where there is a high probability of extension. Then make sure that all of the unsupported enamel edges are removed. The bottom of the prep should be flat and the sides of the dentin parallel or very slightly undercut.

**Bonding**

*Acid etching:* This step is performed with a 37% phosphoric acid. The purpose is to remove all impurities from the tooth surface and slightly demineralize the tooth surface of the tooth. This will lead to increased surface area for bonding. Place the supplied acid on the tooth surface and let stand for 10-30 seconds. After the prescribed time, rinse thoroughly (20 seconds) as insufficient rinsing will result in residual acid remaining in the dentinal tubules and result in sensitivity. Finally, dry the area lightly (do not desiccate) as over drying will weaken bond strength.

*Place bonding agent:* There are many options for bonding agents that fall into two main types: “One Step” which combines the primer and bonding agent in 1 bottle and “Two Step” which have separate primer and bonding agents. In addition, the self-etching systems have shown promise and are less technique sensitive.

The bonding agent should be applied in a very thin layer. After it is applied, it is light cured with an intense blue light in the visible range for 10 seconds.

*Restoration:* For uncomplicated crown fractures, place a layer of unfilled resin over the bonding agent and light cure. This completes the therapy.

For defects to be filled, the composite is placed and then manipulated to fill the defect. This can be done with a plastic filling instrument or a beaver tail coated with unfilled resin. Once the defect is filled (to slightly overfilled) and the restoration roughly contoured, the restoration is light cured. After light curing, the restoration can be smoothed and shaped with white stones, fine diamonds, or sanding discs. Once finished. A layer of unfilled resin should be pace to fill in areas of polymerization shrinkage and smooth the final restoration.

*Follow up:* The patient can eat and drink normally following the restoration. Recheck dental radiographs are strongly recommended in 6-9 months.
Daily brushing is often referred to as the ‘gold standard’ for oral hygiene, as a means of retarding or preventing accumulation of dental plaque and calculus.

When combined with daily flossing, daily brushing maintains immaculate periodontal health in dogs over a long period. However, evaluation of studies of the effectiveness of brushing in dogs is complicated because there are wide variations in reported studies in brushing technique (force applied, teeth brushed, method and duration of application of the brush), frequency of brushing, type of brush, diet fed, duration in time from last brushing to scoring and in scoring methods. Studies have included evaluation of trauma to the gingiva and oral mucosa caused by brushing. These variables and their likely effect on the reported results will be reviewed.

Results of a recent study in dogs to determine the effect of brushing teeth of dogs at various frequencies (daily, every other day, brushing weekly and brushing every other week) using a standardized brushing technique and an ADA-Accepted brush will be presented. Brushing once daily was the most effective, with a rapid fall-off in effectiveness of brushing as the time between brushing was the increased. Brushing every other week was no better than not brushing.
Nanocrystalline silver as therapy tool in periodontitis: A clinical study on adhesive gel

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Introduction

The silver has been used as both preventive tool and remedy for centuries during human history. It has been utilized for treatment of an array of infectious diseases. In ancient world the silver coins had been used as a protective agent in the process of water or other liquid storage. The former farmers used to put a silver coin into the milk container in order to avoid turning sour. The little children were advised to use a silver spoons. These habits were based on an objective feature of the metal. The silver possesses extremely strong antimicrobial properties, as even in the concentration of 10 ppb (parts per billion) it acts as a bacteriostatic agent in liquid. In order to be effective as a bactericidal agent, the silver ions must come into a direct contact with a bacterial wall. The extent of efficiency depends on the ion concentration. The silver ions eliminate bacteria permanently through the blockage of enzymes in mitochondrias and also through disruption of the mitochondrial DNA and bacterial wall structure. The ions do not negatively affect the host cells. In addition to the antibacterial properties, the improvements of wound healing and more rapid tissue restoration after administration have been observed. It is believed that chemical and physical propeties of the matter are changing in connection with the size of particles. Upon common conditions for condensation, tightly connected crystals sized 100-900 nm are created. Decreasing size of the crystals made by a nanotechnology increases the crystal surface which leads to a reaction time shortening. Nanotechnology and the ability to produce silver withing nanocrystalline structure significantly improve biological value of silver.

It can be concluded that silver could replace antimicrobials in some medical indications or at least reduce their usage. At present, the medicine often struggles with infectious complication in small wounds and surgery wounds, and also secondary infections that complicate many other diseases.

In such cases the antimicrobial resistance caused by antimicrobials overuse is a common problem. That is the reason why many researchers look for the new modern non-conventional antimicrobial drugs. That is also the case in veterinary stomatology, as stomatologists prefer to treat periodontitis with antimicrobials as a monotherapy, with no previous periodontal treatment. Unfortunately, the antimicrobial treatment that is not preceded by throughout periodontal treatment has only temporary effect and eventually leads to the development of antimicrobial resistance.

In order to at least partially replace antimicrobials in cases of periodontal disease, we
have gone after the development of a local antimicrobial agent that also possesses properties supporting a periodontal tissue healing after treatment.

Materials and methods

Mucoadhesive gel with persistence on the oral mucosa lasting longer than 3 hours was made after application on the oral mucosa. The gel, combining hydrophilic and hydrophobic properties, contained 200 µg/g of nanocrystalline silver. The size of the silver particles was 15 nm. The gel was administered to clinical patients treated at the KCHP VFU Brno at the period of time between March and July 2014. The patients with clinically manifested periodontitis PDI 2-3 on the teeth 104, 404, 204, 304 were involved in the study. No other aspect was taken into consideration in these patients. In all the patients a standard periodontal exam was performed initially. This included the supragingival teeth calculus removal, closed subgingival curette and depuration of the clinical crown surface. After the procedures, the depth of the periodontal pockets on all four teeth at three points - from the mesial, labial, and distal approach - was measured. The periodontal probe Medin No. 133 50 0116 was used for the measurement. In each patient the owner was applying the gel twice a day on the left side of the occlusion for 7 days. The right side was left with no treatment. After the application the control of the periodontal pocket depth was performed at the same points. Thirty dogs were included in the study, and follow-ups were performed in 16 out of them. The measured values were compared and statistically processed.

In order to evaluate the data we initially used a normality test (Shapiro-Wilk) and consequently, based on the result, we chose a parametric test - a pair t-test. The comparison of measured values observed on the right and left side before administration of the gel was performed by a normality test. The reason for the comparison was to find out if the statistically significant difference in a depth of periodontal defects between both side of occlusion was or was not yet present before the treatment by a nanocrystalline silver had started. The comparison of depth values in periodontal pockets on the side treated with gel (204, 304) and untreated side (101, 404) was performed by a pair t-test. The comparison of depth values in periodontal pockets on the side treated with gel (204, 304) and untreated side (101, 404) was performed by a pair t-test. The question to answer was whether healing of periodontal pockets treated with gel will proceed better compared with the untreated side. Firstly, the comparison of the values obtained immediately after periodontal treatment and before the administration of nanocrystalline silver was performed. The periodontal pocket in 104 was compared with the periodontal pocket in 204, and the periodontal pocket in 404 was compared with the periodontal pocket in 304. The same comparison was made in values obtained after seven-day therapy with nanocrystalline silver.

Results

A normality test (Shapiro-Wilk): Passed (P = 0,218)
Statistical evaluation: Paired t-test:

<table>
<thead>
<tr>
<th>Localization</th>
<th>Before application</th>
<th>After application</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ag - 104</td>
<td>3,9 mm ± 1,8 mm</td>
<td>3,3 mm ± 1,4 mm</td>
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<tr>
<td>Ag - 404</td>
<td>4,5 mm ± 1,6 mm</td>
<td>3,4 mm ± 1,5 mm</td>
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<tr>
<td>Ag+ 204</td>
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<td>2,4 mm ± 1,0 mm</td>
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<tr>
<td>Ag+ 304</td>
<td>4,1 mm ± 1,4 mm</td>
<td>2,6 mm ± 1,0 mm</td>
<td>0,001</td>
</tr>
</tbody>
</table>
Conclusion

It has been proved that periodontal pockets treated with the gel containing nanocrystalline silver heal better compared with untreated periodontal pockets. It can be concluded that nanocrystalline silver in appropriate drug form can be used as a complementary part of the complex periodontal therapy.
Mesenchymal stem cell therapy for feline chronic gingivostomatitis: concept, progress and obstacles

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Feline chronic gingivostomatitis (FCGS), an oral inflammatory disease of cats, can be debilitating, difficult to treat, and may result in euthanasia of severely affected cats. The lesions are commonly identified near the caudal aspect of the oral cavity at the palatoglossal folds, with extension along the buccal and gingival mucosa crossing the mucogingival junction. The clinical entity is thought to be a multifactorial condition where the host immune system is responding inappropriately to stimulation. Histologically, these lesions consist primarily of lymphocytes (mixed B and T cells) and plasma cells, with fewer neutrophils, and mast cells.

Medical treatment of FCGS has been unrewarding with no specific treatment showing superiority. Full-mouth or near full-mouth tooth extractions have shown the best results so far. Cats with refractory disease require constant medical therapy. Corticosteroids are often used to decrease oral inflammation. Recently, recombinant feline interferon omega has been proposed as a treatment for refractory FCGS cases.

Mesenchymal stem cells (MSC) are multipotent stem cells. MSC reside in most organs and tissues such as bone marrow, adipose, and periodontal ligament. Furthermore, MSC have a profound regenerative ability attributed in part to their ability modulate both innate and adaptive immunity. MSC inhibit T-cell proliferation, alter B-cell function, down-regulate MHC II and inhibit dendritic cell maturation and differentiation. Therefore, our group is investigating systemic MSC therapy for cats with non-responsive FCGS. This lecture will outline the concept of MSC immunomodulation clinical outcome of MSC therapy for cats with FCGS and the obstacles encountered in pursuing cell therapy for cats.
The objective of the present study was to evaluate analgesic effect of meloxicam and tramadol following dental extractions in cats. 20 cats who were diagnosed with 3rd or 4th stage of periodontal disease at their third mandibular premolar were entered the study in order to perform surgical dental extraction. A blood sample was taken prior to surgery to assess the level of cortisol and CPK. General anesthesia performed using ketamine and diazepam (IV, 8.5 mg/kg+0.2 mg/kg) and inhalation of isoflurane following intubation. 3rd mandibular premolar extracted in all of the patients using similar procedure. The cats were randomly selected into two groups of A receiving Meloxicam (IV, 0.2 mg/kg) or B, receiving tramadol (IV, 3 mg/kg) at the time of induction of anesthesia. The analgesics were continued after the surgery for 24 hours. The score of pain were recorded using UMPS and assessment of serum level of cortisol and CPK at 2, 4, 24 and 48 hours after the surgery performed.

The highest score of pain was recorded at 4 hours after the surgery in both groups. No significant differences were recorded in the score of pain, cortisol and CPK between groups at 4 and 6 hours postoperatively (P>0.05). However the score of pain and level of cortisol were higher at 24 and 48 hours in group B (P<0.05). It is concluded that although tramadol and meloxicam are both effective in reducing pain at early hours after the surgery, meloxicam is superior to control pain during the days in phase of inflammation.
The objective of this retrospective study was to evaluate wire-reinforced interdental composite splint for the treatment of mandibular body fractures in 24 small breed dogs (<10 kg).

Data collected included history (dog's details, cause of fracture, duration until presentation, former treatment devices used), initial clinical data (radiological lesions, dental intervals involved, teeth in the fracture line, former treatment devices used, periodontal involvement, type of fracture, treatment data (dental anchorage, wiring technique, accessory devices, intubation technique, the nutritional support method, teeth management technique, teeth management moment), follow-up data (number of visits, mean visit interval, time to clinical healing and complications). The fracture line angle and the horizontal displacement of the fragments were measured on digital dental radiographs.

Mean age of the dogs was 7 years. Shih-tzu was the most represented breed (9/14) followed by Yorkshire terrier (6/14). The fractures were caused by trauma (40%), dog's bite (40%) or pathological fractures (20%). Thirteen of the dogs (54.2%) were treated for the first time and 11 (45.8%) were referred for failure and/or complications after a previous treatment attempt. Twenty-five mandibular fractures were observed, 24 (96%) were open fractures in the oral cavity and 5 of them (20%) were also associated with a cutaneous wound. The most frequent fracture site was P4-M1 area (56%). The mean time to clinical healing was 2.37 months. It was significantly greater when teeth were involved in the fracture line (p=0.012). A significant correlation (p<0.001; r=0.61) was noted between time to clinical healing and fracture line angle.
Purpose of research: A bilateral rostral mandibular defect in dogs may be a sequel of oncologic surgery or trauma. This results in malocclusion and difficulty in eating and drinking. It also causes difficulty in prehension and potentially pain in the temporomandibular joints. Therefore, the ideal treatment should be reconstruction, potentially through bone regeneration. Ideally, the final outcome should allow appropriate biomechanics and a functional, pain-free occlusion. In addition, using tridimensional (3D) printing for surgical planning adds to the understanding and precision of the procedure.

Study methodology: Dogs requiring bilateral rostral mandibulectomy were included in the study. Following computed tomography (CT) and dental radiographs, 3D-printed skulls were generated and used for surgical planning. Rostral mandibulectomy was performed followed by reconstruction using internal fixation and a compression-resistant matrix (CRM) infused with rhBMP-2.

Results: To date, 5 dogs, aged 3–10 years (mean 6.8 years) weighing 25.8–64.3 kg (mean 34.8 kg) had bilateral rostral mandibulectomy for the removal of squamous cell carcinoma, canine acanthomatous ameloblastoma, or ossifying fibroma. Follow-up is up to 20 months to date. All dogs had appropriate occlusion postoperatively and throughout the follow-up. On follow-up CT evaluation, there was evidence of new bone formation with complete integration of the implant material with the native mandible. No adverse affects were noted apart from a temporary partial plate exposure in one dog. No tumor recurrence was noted throughout the follow-up period.

Conclusion: Rostral mandibular reconstruction using internal fixation and CRM infused with rhBMP-2 is an excellent solution for reconstruction of the rostral mandible in dogs. Using 3D printing as a surgical planning tool improves understanding and precision of the surgery.

Reference list


Periodontitis is the most commonly diagnosed health problem in cats. Despite the prevalence of the disease, little is known about its cause in cats. In other species, it has been established that the bacterial population of plaque is responsible for triggering the disease. To understand the role of bacteria in feline periodontitis we have extensively characterised the bacterial species found in plaque. In our first study we developed a feline oral taxon database of 171 oral species and built a phylogenetic tree that will aid future research in this area. In a further study of plaque from 92 cats with a range of different oral health states from healthy through to mild periodontitis, we used next generation sequencing technology to generate more than 1.1 million reads, at an average sequencing depth of more than 12,000 sequences per sample. In this study, we identified a total of 267 operational taxonomic units after bioinformatic and statistical analysis. Porphyromonas was the most abundant genus in all health states, particularly in the healthy state, in which Moraxella and Fusobacteria were also prevalent. The Peptostreptococcaceae were the most abundant family in gingivitis and mild periodontitis. Logistic regression analysis identified species from various genera that were significantly associated with health, gingivitis or mild periodontitis. The bacterial species associated with both healthy plaque and plaque from mild periodontitis in cats were very similar to those found in dogs. For example Bergeyella zoohelcum and Moraxella species were health associated in both cats and dogs whilst Filifactor villosus and Clostridiales species were disease associated in both. In contrast, the feline oral health associated species were very different to those found in healthy human plaque. At the species level, there were also large differences between the feline and human oral bacteria associated with periodontitis. However at a higher level of classification, the Phyla associated with disease progression were the same in both human and cat, with Firmicutes, Spirochetes, Synergistetes, Chloroflexi and TM7 all more prevalent in mild periodontitis relative to the healthy state. Understanding the role of bacterial species in periodontitis should in the future allow interventions to be designed to slow or halt the disease process.
Root perforation during endodontic procedures is not necessarily common, but when it does occur, it represents a serious problem that definitely decreases the prognosis of the involved teeth. Furcation perforations proved to have the worst prognosis of all types of root perforations. The present study aimed to evaluate mineral trioxide aggregate (MTA) for furcation perforation repair with and without calcium sulphate. 72 teeth were used in this study that divided into 3 groups, each group include 24 teeth. Group I (control group), group II (treated with MTA only) and group III (treated with MTA and calcium sulphate as artificial floor). Clinical, radiographic and histological evaluation was performed at 1, 3 and 6 months intervals. The study revealed that MTA material is of good biocompatibility and calcium sulphate with MTA allowed the highest histological manifestation of success than MTA alone. The study recommended that when using MTA for furcation perforation repair, it should be preceded by application of calcium sulphate as artificial floor where better results were achieved.
Evaluation of the repair of contaminated furcation perforations using mineral trioxide aggregate or BioAggregate in dogs

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Introduction: Perforation is a mechanical or pathological communication between the root canal system and the external tooth surface. It can be produced iatrogenically causing endodontic failure. In clinical endodontics, there are several filling materials for perforation repair. The aim of this study was to evaluate the healing of furcation perforation following treatment with MTA or BioAggregate in dogs.

Methods: The present study was carried out on a total of 54 premolar teeth in 6 adult mongrel dogs. The teeth were randomly classified according to the observation period into three groups (2 dogs each); I (one week), II (one month) and III (3 months). Exposure of the pulp chamber, pulp tissue removal, root canals instrumentation and obturation were carried out through endodontic access cavities in all teeth. Then a 1.4 mm-diameter perforation was done at the center of the pulp chamber floor in all teeth. The access cavities were left open for 4 weeks. Each group was further subdivided according to the treatment protocol into three subgroups; subgroup a (MTA), subgroup b (BioAggregate) and subgroup c (positive control). Radiographic and histologic evaluations were carried out. Data were analyzed using SPSS. One-way ANOVA test was used to compare the inflammatory cell counts among different groups and subgroups. For non-parametric data, Kruskal-Wallis test was used. P value <0.05 was considered significant.

Results: The statistical analysis revealed that MTA and BioAggregate had a similar biological response on the periodontal tissue. There was no significant difference between MTA and BioAggregate subgroups regarding furcation radiolucency, inflammatory cell count, epithelial proliferation and new hard tissue formation.

Clinical relevance: BioAggregate cement is a good alternative of mineral trioxide aggregates cement for repair of contaminated furcation perforation in dogs.
Introduction: Furcation perforation is regarded as a serious complications in dental practice. It usually occurs during a search for a canal orifice. Numerous materials have been used for furcation perforation repair but none was an ideal biomaterial. Therefore, the aim of this study was to assess the effect of mineral trioxide aggregate (MTA), platelet rich plasma (PRP) or platelet rich fibrin (PRF) on healing of non-contaminated furcation perforations in dogs, teeth.

Methods: A total of 96 teeth of six mongrel were divided into three equal groups according to the evaluation period; group I (one week), group II (2 months) and group III (3 months). Each group (32 teeth) was further subdivided into MTA, PRP, PRF, negative and positive control subgroups. Root canal therapy was carried out, furcation perforation (1 mm length) was made and repaired immediately in all teeth except in negative control subgroup. The change in vertical bone loss was measured by radiography. Histological evaluation of the specimens was performed. Data were analyzed using SPSS (19.0, IBM, Armonk, NY, USA). Numeric data were analyzed by the Kruskal–Wallis nonparametric analysis of variance. Mann-Whitney, Friedman’s and Wilcoxon signed-rank tests were used to identify differences between the groups and subgroups. P value <0.05 was considered significant.

Results: No significant difference was found between MTA, PRP and PRF in reduction of vertical bone loss cemental deposition, new bone formation, bone resorption and epithelial proliferation.

Clinical relevance: Platelet rich plasma and platelet rich fibrin are successful treatment options for repair of furcation perforation in dogs.
Root perforation is an artificial communication between the root canal system and supporting tissues of the tooth through the root canal wall or the pulp chamber floor. Perforation repair should maintain healthy tissues against the lesion without persisting inflammation or loss of periodontal attachment as well as sealing of dentin defect to allow a suitable environment for formation of a new periodontal attachment. A new Nano-Filled Resin Modified Glass Ionomer restorative material (Nano-FRMMGI) has been introduced for restoration of primary teeth and small cavities in permanent teeth. The aim of the present study is to evaluate the clinical performance and tissue reaction of Nano-FRMMGI. 48 teeth from 3 healthy dogs were used and divided into 2 groups (24 teeth each), Group I: Treated with Nano-RGMI and Group II: Control group. Clinical, radiographic and histological evaluations were performed for both groups. The perforation of the pulp chamber floor was found to have a questionable prognosis with Nano-FRMMGI. Repairing of furcation perforations in the molars showed better clinical and histological success more than the premolars. Mandibular teeth achieved significantly better prognosis than the maxillary teeth. Proper sealing of furcation perforations was found to be essential for initial favorable tissue reaction. From the present study, it was concluded that, Nano-FRMMGI should not be the first choice for furcation perforation repair.
Temporomandibular joint injuries may result in restriction of the mandibular movement. They are compromising conditions which may disable mastication. Condylectomy is the treatment of choice for joint ankylosis. Complications may occur postoperatively.

The objective of the present retrospective study is to determine the cause, type of injury, means of treatment and clinical outcome of traumatic temporomandibular joint injuries in cats.

The medical records were retrieved from the archives of the unit of surgery, Companion Animal Clinic, Aristotle University of Thessaloniki (2009-2014). During this period 10 cats were presented with various joint injuries. The mean age at the time of presentation was 15.1 months. The cause of injury was usually unknown while the most common reason of admittance was the inability of mouth opening (7/10 cats). The most common type of injury was fracture of the condyle and/or callus formation. Five cats were referred after unsuccessful operations. Condylectomy was the main surgical technique used. Four cats underwent bilateral condylectomy and four others unilateral. Recurrence was seen in three cases. In two cases, the mouth was stabilized open with the successful use of resin on the canines. Recurrence was seen in one case. Slight malocclusion was reported in six and salivation in three cats in the follow up. The vast majority of the owners were satisfied with the outcome, despite the minor complications.
A young dog was presented with an oral mass swelling rostro-vestibular of the left mandibular associated with agenesis of the adult canine. The mass was hard with no fluctuant aspect and present a rapid evolution other the last month; at the moment the mass is 4/7 cm and present an osteolytic process on general radiography examination.

**Anaesthesia:** Acp, morphine, Isoflurane 1.5%, loco regional articaine. Meloxicam post-operative. (Monitoring ECG, Capnographe, T °)

**Cone Beam 5G:** native axial section of 0.125 m and MPR reconstruction of 0.125 mm; panoramic reconstruction; Total exposure time: s 7.3: mAs: 19.62. kV 110kV; CDTIVol: 2.90 mGy

**Description:** development from left M1 to I3 of a mass with cystic appearance intruded in the left mandibula. It is observed major thinning of the cortical walls with severe punctiform lysis. Adult canine and dental fragments are included in the lesion. A dense content with significant mineralization fill the overall lesion.

**Conclusion:** Odontogenic Tumor suspicion; “ameloblastic” characteristic but a rather aggressive evolution. Compromised peripheral bone structures with surgical treatment plan challenge.

**Incisional Biopsy:** a mucco gingival flap was elevated and different samples collected (decidual teeth + bone+ amorphous tissue) 1 stay suture.

**Prescription:** Strict control of biting games; the treatment is waiting for the results and planned for within 10 days.

**Defect evaluation:** particular attention will be paid to the ability to maintain the integrity of the mandibular symphisis given the young age of the dog but this depending on the aggressiveness of the Odontogenic tumor (benign tumor, but with aggressive local behavior)

**Histology:** “pieces of analysis show the presence of clusters of very erratic and immature dental structures (rudimentary teeth) evolving within an abundant tissue mesenchymal hosting rare and very small islands epithelial rests cells of Malassez.

The mesenchymal component, densely cellular, is quite richly vascularized and composed of beams with variable orientation of fusiform cells from fibroblast allure. These cells have a round core to oval in decondense chromatin punctuated with a small nucleolus.

A slight anisocaryose to moderate is noted but the nuclei are almost never observed in mitosis.
Conclusion: Biopsies within a well differentiated fibroblast mesenchymal proliferation organized around dental type organoids rudimentary structures. Absence of major atypical on the mesenchymal component. The Histopathogenesis of this proliferation remains unclear but the important mesenchymal component associates to rudimentary dental structures evokes priority an ameloblastic fibro odontoma rather than an odontoma.

Surgery: a flap elevation mucosal gingival periosteum; enucleation of the fibrome and extraction of impacted teeth; extensive curetage of the inner walls of the defect from all residual tissue components. Filling of the bone deficit by a bioresorbable bone void filling substitute isolated with a resorbable collagen membrane. Sutures 2 plans.

Prescription: continuation of the antibiotic for 10 days. Strict control of biting Games time to healing and functional adaptation of the mandible (minimum 2 months).

Cone Beam 5G post op: absence of residual tooth fragment include; satisfactory in bio materials filling (compaction vs. voids).

6 months recheck
Satisfactory general condition, very good oral healing, injury “ulcerative” puncture at the level of the labial frenulum.

Cone Beam 5G: Absence d’image compatible with une récidive de prolifération de tissu dentaire adhérent ou kystique.

No images compatible with regrowth of attached or cystic dental tissues.

Very satisfactory bone healing; defect filling at the biomaterial ridge; persistence of biomaterial included in the neo organic bone matrix; homogeneity of the neo os satisfactory.

Evidence in two different sites of one granule of ceramic calcium in the sub mucosal layer (labial frenulum), compatible with the development of the observed fistula.

Conclusion: oral and bone healing satisfactory; full integrity of the left mandible (height/width). Fistula associated with the migration of of calcium ceramics granules in mucosal slot.

Favourable surgical outcome.

1 year recheck
Satisfactory general condition, very good oral healing.

Cone Beam 5G: absence of a recurrence of proliferation of dental tissue-compatible image attached or cystic. Very satisfactory bone healing, filling in the amount of the organic materials, itself undergoing resorption replacement by cancellous bone. homogeneity of the os neo satisfactory.

Discussions

Different aspects of the treatment strategy will be discussed.

Differential histologic diagnosis: Benefit of a combination between precise imaging system – oral pathology knowledge.

Surgical margins management: Benefit of a good understanding of oral pathology on surgical margins decision.

Surgical defect management: Benefit of a good understanding of guided tissue regeneration concepts.
Globe penetration in a cat following maxillary nerve block for dental surgery

Rachel Perry¹, Denise Moore¹ & Emma Scurrell²

Introduction

An elegant and contemporary approach to pain management in small animal dentistry involves the use of multimodal and pre-emptive analgesia. Peripheral neural blockade describes the use of local anaesthetic agents to selectively block specific nerves thus desensitising certain regions of the body or head (regional anaesthesia or nerve block). This may form part of a multi-modal approach while simultaneously contributing to pre-emptive analgesia. Easily identifiable landmarks are often used as a guide to direct needle placement. Various blocks are described in the veterinary literature for both dogs and cats. Human dentists administer thousands of local anaesthetic injections daily, with this being the most common form of peri-operative pain control. Misjudging the anatomy of the area concerned may not only result in inadequate analgesia, but more serious local or systemic complications. These incidents appear to be relatively rare but even experienced human dental practitioners are urged to take time to review the anatomy involved. In human medicine the research tends to focus on nerve injury associated with regional nerve block, but the overall risk associated with regional anaesthesia remains poorly defined.

While complications associated with regional anaesthesia in dogs and cats are described, these appear to be extrapolated from human research into systemic toxicity. To the authors’ knowledge there have been no reports in the literature of local complications and only one report of a severe, systemic complication arising from a dental nerve block in the cat. It may be that complications arising from veterinary dental regional anaesthesia are genuinely rare. Alternatively, it may be that they are under-reported. This article describes globe penetration in a cat following maxillary nerve block during dental surgery. The purpose of this article is to highlight this risk and to review the safest and most efficacious regional anaesthesia technique for the feline maxilla.

Case report

An 8.5 year old castrated male domestic shorthair cat was presented for routine annual vaccination. During the clinical examination, tooth resorption was noted on the buccal aspect of the permanent right maxillary third pre-molar tooth. No other clinical abnormalities were noted on oral or general physical examination. A recommendation was made for dental assessment and treatment under general anaesthesia. A week later,
the cat was admitted for dental treatment by a general practitioner. Pre-anaesthetic blood tests were within normal limits (albumin, ALKP, ALT, urea, creatinine, globulin, glucose, total protein, sodium, potassium and chloride). An intravenous catheter was placed in the left cephalic vein in a sterile manner and Hartmann’s solution administered intravenously at maintenance rate (2ml/kg/hour) rising to surgical rate (10ml/kg/hour) during anaesthesia. The cat was pre-medicated with a combination of acepromazine (0.03mg/kg) and buprenorphine (20µg/kg) given by intra-muscular injection. Induction of anaesthesia was achieved using propofol (6mg/kg) intravenously to effect over 40 seconds. The trachea was intubated with a size 4.0mm endotracheal tube of suitable length. This was inflated until the escape of gas was prevented with the application of moderate positive pressure. Anaesthesia was maintained using isoflurane mixed with oxygen delivered via a mini-Lack circuit. Non-invasive blood pressure, oxygen saturation, body temperature, heart rate, respiratory rate and end-tidal CO2 were monitored continuously throughout the procedure and recorded every 5 minutes. Body temperature was supported by use of a circulating warm air blanket. Oral examination and intra-oral dental radiography confirmed the presence of tooth resorption in several teeth. A treatment plan was formulated which included the provision of regional anaesthesia. A right mandibular and right and left maxillary nerve blocks were administered using a 1ml syringe attached to a 25Gx 5/8" needle, with a total dose of 0.75mg/kg bupivacaine. The maxillary nerve blocks were performed using an intra-oral technique, advancing the needle dorsally caudal to the molar tooth, directing the needle tip towards the maxillary foramen in the pterygopalatine fossa. To assist this, the needle was pre-bent at a 45° angle to direct the needle tip rostrally towards the foramen. Aspiration was performed before injection of the bupivacaine. A corneectomy was performed on the right maxillary third pre-molar, while the left maxillary third pre-molar and right mandibular third pre-molars were extracted in an open manner. The gingiva was sutured with poliglecaprone 25 in a simple interrupted pattern. Recovery from anaesthesia was uneventful. The cat was discharged and the owner instructed to keep the cat indoors overnight. Meloxicam was prescribed to be given orally once daily for post-operative pain control. The next morning the cat displayed blepharospasm of the right eye, and veterinary attention was sought.

Examination demonstrated a small superficial corneal ulcer, subtle corneal oedema, a very cloudy anterior chamber and iritis. The retina could not be visualised. Topical ofloxacin drops (at a frequency of one drop, six times daily) were added to the systemic treatments. Two days later, the patient was reviewed. It was dull and anorexic. Ocular examination revealed ongoing signs of uveitis. The corneal ulcer had healed, thus a combined steroid/antibiotic topical drops (dexamethasone, neomycin and Polymyxin B) were prescribed. The cat’s body temperature was 38.5°C. A blood sample was taken for feline viral testing (FeLV, FIV, coronavirus) and for routine biochemistry and haematology. A toxoplasmosis titre was not assessed at this time. Results were within normal limits apart from a mild eosinophilia (0.96 x 109L [normal 0.10-0.79 x 109/L]). No improvement in the condition of the eye was noted, and two days later the opinions of an ophthalmologist and veterinary dentist were sought.

Ophthalmic examination confirmed a blind right eye. The right eye demonstrated blepharospasm, a negative menace response and a negative direct pupillary light response. Marked uveitis was apparent with diffuse corneal oedema, large keratic precipitates over the corneal endothelium, a large clot of organising inflammatory cells and some small organising blood clots in the ventral anterior chamber, an organising post-inflammatory membrane across the pupil resulting in some distortion in the pupil shape and iritis. It was not possible to visualise any posterior segment structures through the anterior segment opacities. The left eye appeared unremarkable. Intraocular pressures (IOP) were 6
and 9 mmHg in the right and left eyes respectively. Ocular ultrasonography was then performed. This demonstrated increased echogenicity of the aqueous, thickened iris tissue, some hyperechoic strands (suspected post-inflammatory membranes) within the vitreal chamber which appeared to be arising from the ventrolateral aspect of the globe, and retinal detachment.

Since this cat’s eye problem became evident within 24 hours of dental surgery being performed the ophthalmologist had to suspect that the eye had suffered a penetrating injury during the dental procedure. A poor prognosis was thus given for the right eye and enucleation of the right eye was discussed. This was performed as a secondary glaucoma soon developed (IOP 43 mmHg). A standard transpalpebral enucleation technique was performed under general anaesthesia. The cat made an uneventful recovery from the surgery.

The globe was fixed in neutral buffered formalin and submitted for pathological examination. On gross examination of the globe, a small (0.5-0.7mm) focal penetrating injury was identified in the ventral sclera. The globe was then sectioned in half to include the scleral lesion, routinely processed for histopathology and embedded in paraffin. Sections were cut at 4µm and stained with hematoxylin and eosin (H&E). Histopathological findings confirmed the presence of a focal linear penetrating wound disrupting the sclera, choroid and retina associated with focal pathological detachment of the ventral retina, neutrophilic and lymphoplasmacytic endophthalmitis, mild intraocular haemorrhage and secondary glaucoma. The discrete linear morphology of the penetrating injury was consistent with that expected from a needle tract and did not support scleral rupture secondary to blunt trauma.

**Discussion**

The contemporary approach to veterinary practice includes careful anticipation and prevention of pain in patients under our care. This includes the provision of multimodal analgesia, which utilises different classes of drugs to block the ultimate conscious perception of pain by interrupting the pain pathway at different points, maximising analgesic provision. The rationale of pre-emptive analgesia is to prevent initial afferent signals reaching the central nervous system, and thus reduce the risk of altered processing of afferent input which could amplify post-operative pain. Local anaesthetics are the only drugs that produce complete blockade of peripheral nociceptive input, and are therefore the most effective way of preventing central sensitisation. Peripheral neural blockade describes the use of local anaesthetic agents to de-sensitise specific nerves using anatomical landmarks and provide analgesia to a region of the body or head, and this is the most common form of peri-operative pain control in human dentistry. Veterinary patients may benefit from local anaesthetic techniques under general anaesthesia as decreased peri-operative pain may result in better autonomic stability and reduced cardiovascular, respiratory or central nervous system (CNS) depression contributing to a safer anaesthetic, smooth recovery and rapid discharge from the hospital. Some longer acting drugs such as bupivacaine may also provide analgesia into the post-operative period.

The overall incidence of complications associated with human dental anaesthesia appears to be low, with local anaesthetic drugs being relatively safe drugs when used with care. Placement of the agent is critical in both ensuring efficacy and reducing unwanted side effects. Complications may arise as a direct result of the needle placement, or due to the toxicity of the drug used. Toxicity may result from overdose or inadvertent intravenous administration of the drug resulting in CNS disturbances or cardiorespiratory arrest. Increased safety can therefore be obtained by aspirating before injection to
ensure it will not be intravenous, and calculating the maximal dose permissible to avoid
overdose.\textsuperscript{3,6,7,20} Local complications include: needle breakage, trismus (inability to open the
jaw) prolonged anaesthesia or paraesthesia, paralysis of motor nerves, and interference
with special senses such as vision.\textsuperscript{11,12,24-26}

The reporting of procedure-related complications is common in both human and vet-
erinary medicine. However, there is a lack of acceptable and reliable reporting criteria
in relation to regional anaesthesia. A systematic review of human regional anaesthesia
peer-reviewed literature in 2009 found both an inconsistency and lack of outcome report-
ing in prospective studies, meaning that comparing results of safety-related issues may
be difficult.\textsuperscript{13} There are reports of complications arising from regional anaesthesia in the
dog and cat, but these are primarily associated with epidural administration of drugs.\textsuperscript{22,23}
There are very few reported complications arising from the use of dental nerve blocks in
dogs and cats, but severe cardiovascular depression has been reported after a mandibular
nerve block in a cat using bupivacaine.\textsuperscript{16} Lingual trauma has been reported in the horse
following inferior alveolar nerve block, and is also anecdotaly reported in cats and dogs.\textsuperscript{27}

Regional anaesthesia is also used during human ophthalmic surgery and complica-
tions including globe perforation or penetration are reported.\textsuperscript{28} Similar regional anaes-
thetic techniques are used in cattle, horses, dogs and cats for ocular surgery.\textsuperscript{29,30} The blocks
may also be associated with globe perforation and penetration due to the blind placement
of the needle. Cadaveric studies in equines suggest ultrasound guidance may improve the
retrobulbar nerve block’s safety and efficacy.\textsuperscript{31} Orbital penetration by dental elevators has
been reported during tooth extraction in dogs and cats.\textsuperscript{32} This is a particular risk during
extraction of caudal maxillary molar teeth due to the proximity of the tooth roots to the
ventral orbit.\textsuperscript{33,34}

Anatomy

There are three primary divisions of the sensory part of the trigeminal nerve (ophthal-
mic, maxillary and mandibular). The maxillary nerve supplies sensation to cheeks, nose,
soft and hard palates, upper teeth and gingivae.\textsuperscript{35} It leaves the cranial vault via the round
foramen, coursing ventral to the orbit in the pterygopalatine fossa, before entering the
infraorbital canal via the maxillary foramen. Within the infraorbital canal, branches of the
now eponymously named infraorbital nerve supply all teeth before exiting the canal at the
infraorbital foramen where it becomes purely sensory to the skin of the nose and upper
lip.\textsuperscript{35} The infraorbital canal is much shorter in the cat than the dog and may only be a few
millimetres long.\textsuperscript{4,34,35} The cat possesses large, prominent eyes with an incomplete orbit. The
orbital ligament connects the zygomatic and frontal bones in the dorso-temporal region.\textsuperscript{36}
Important soft tissue structures in the ventral orbit include the maxillary and ophthalmic
arteries, orbital veins and venous plexus, and pterygopalatine nerve.\textsuperscript{30,33,36} The tooth roots
of the maxillary 4th premolar and first molar in the cat lie very close to the ventral orbit.\textsuperscript{32,33}

Maxillary nerve block

Using local anaesthetic agent to block the maxillary nerve before it enters the infraorbi-
tal canal should desensitise the ipsilateral upper teeth and lip, nose, maxilla, incisive bone,
hard and soft palates.\textsuperscript{44} Several techniques have been described to perform the maxillary
nerve block in the dog and cat, but unfortunately a distinction is often not made between
the canine and feline patient.\textsuperscript{4,9} Extrapolating from a technique used in dogs may not be
appropriate due to anatomical differences between the species. Furthermore, some publi-
cations are inaccurate and misleading.\textsuperscript{9,37}
The percutaneous approach inserts the needle just below the ventral border of the zygomatic arch, at the junction of the maxilla parallel to the hard palate and directs it towards the pterygopalatine fossa and maxillary foramen. There are two intraoral approaches. The first is described in cats by directing the needle dorsally via the notch palpable at the hard and soft palate juncture caudal to the molar tooth. Disadvantages of this technique are described and concern the blind placement of a needle in the retrobulbar space. The other intra-oral approach is via the infraorbital canal and is described as the deep infraorbital block. Some author suggests this approach should be chosen in the cat as the infraorbital canal is so short it allows advancement of the needle to the maxillary nerve via the infraorbital foramen. Another intra-oral approach is described in dogs using an intravenous catheter to place local anaesthetic at the level of the lateral canthus of the eye via the infraorbital foramen, similar to the deep infraorbital block. Using a catheter in this study was hypothesised to reduce the risk of iatrogenic needle damage to infraorbital nerves and blood vessels, and the distribution of dye in this study supported this hypothesis. Further studies would be required in a clinical setting to confirm these findings. What is unknown in this procedure is the effect of pressure on the infraorbital nerve after injecting a volume of liquid into an enclosed space.

The infraorbital nerve block has been shown to be effective in abolishing reflex-evoked muscle action potentials from stimulated maxillary fourth premolar teeth in cats where the needle was advanced 0.5cm into the canal. However, the infraorbital canal in the cat is described as being only a few millimetres long (<4mm) so that the use of a long needle placed into this canal, or advancement further than the lateral canthus of the eye may penetrate the globe. Globe penetration can therefore be avoided by not directing a needle further than 2-3 mm into the canal, and directing the needle ventrally not dorsally towards the globe. Blocking the infraorbital nerve as it exits the eponymous foramen seems logical in terms of safety, but it will not provide any dental analgesia as the nerve at this location is purely sensory to the nose and upper lip. Digital compression over the infraorbital foramen for 30 seconds after injection may help the anaesthetic agent to reach the target area though there is a lack of evidence to support this practice. The infraorbital canal is located dorsal to the maxillary 3rd pre-molar tooth and can be palpated easily through the oral mucosa. The foramen is palpated with the non-dominant hand, and the lip retracted dorsally. The needle is advanced caudally towards the foramen, keeping the bevel pointed towards the bone. Once the needle enters the foramen, aspiration is performed to ensure it is not intravascular, and the agent slowly deposited.

References


A 17 month old female spayed Red Setter Border Collie Cross with severe refractory oral papillomatosis of 8 months duration at the time of presentation. Duration of clinical oral papillomatosis was 15 months in total.

<table>
<thead>
<tr>
<th>Date</th>
<th>Treatments and medications</th>
</tr>
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<tbody>
<tr>
<td>Dec 28, 2011</td>
<td>Azithromycin 10 mg/kg/day for 10 days (owner noticed first wart on nose Oct 2011).</td>
</tr>
<tr>
<td>Mar 28, 2012</td>
<td>Surgical debulking and crushing some warts.</td>
</tr>
<tr>
<td>Apr 18, 2012</td>
<td>Azithromycin 10 mg/kg/day for 20 days with Cimetidine 250mg PO BID. Sometime early in the spring given by owner prescribed from Dr. Google Thuja Ocic DR pellets/granules 3 pellets one day and three two weeks later.</td>
</tr>
<tr>
<td>July 12, 2012</td>
<td>Interferon 20,000 IU PO SID, Vitamin E 400IU PO SID, Vitamin C 1000mg PO SID, L-lysine and Thuja Ocic DR pellets/granules 3 pellets twice a day for two days.</td>
</tr>
<tr>
<td>Aug 02, 2012</td>
<td>Referral to dermatologist, CBC, Chemistry and thyroid WNL, Oral interferon was continued at 20,000 I.U. PO per day, Zinc Sulphate 100mg PO BID.</td>
</tr>
<tr>
<td>Aug 02, 2012</td>
<td>Referral to Dr. Jacobson. Evaluation under sedation as dog is no longer able to eat or swallow normally, owners were considering quality of life issues for this patient. Weight loss marked; BCS 3/9. Metacam 4.25mg SQ, Clindamycin 210mg IM and added Metacam 1.4 mg PO SID, Clindamycin 300mg PO BID.</td>
</tr>
<tr>
<td>Aug 07, 2012</td>
<td>Referral to mentor for surgical debulking with laser at West Coast Veterinary Dental Services, Tramadol 100mg PO TID for 3 days, Sulcrafate 1G PO TID for 2 days, Metacam 1.4 mg PO SID, Clindamycin 300mg PO BID for 21 days.</td>
</tr>
<tr>
<td>Aug 27, 2012</td>
<td>Further surgical debulking with electrocautery Tramadol 100mg PO TID for 4 days, Metacam 1.5 mg PO SID, Diet change to Mobility Support, increased Vitamin E 800 I.U. PO SID, Vitamin C 2000mg PO SID.</td>
</tr>
<tr>
<td>Date</td>
<td>Treatments and medications</td>
</tr>
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<tr>
<td>October 09, 2012</td>
<td>Stopped interferon, continued increased Vitamin E 800 I.U. PO SID, Vitamin C 2000mg PO SID, started Immunoregulan (Eqstim) 5 mls divided into two doses IM epaxial muscles every 5 days, surgically debulked more warts</td>
</tr>
<tr>
<td>Nov 20, 2012</td>
<td>Extracted 310 and surgically debulked more warts Tramadol 100mg TID for 4 days, Clindamycin 300mg PO BID for 10 days and Metacam 1.7mg PO SID.</td>
</tr>
<tr>
<td>Dec 15, 2012</td>
<td>Last dose of Immunoregulan.</td>
</tr>
<tr>
<td>Jan 18, 2013</td>
<td>Surgically debulked more warts, extracted 310, Tramadol 100mg TID for 4 days, Clindamycin 300mg PO BID for 10 days and Metacam 1.7 mg PO SID. This was the last of the clinical oral papillomatosis. Oral papillomatosis vaccinations were not tried as they are not legally available in Canada.</td>
</tr>
<tr>
<td>May 29, 2013</td>
<td>Dog is still free of any recurrence of oral papillomatosis. Dog is not on any medication.</td>
</tr>
<tr>
<td>Dec 2013</td>
<td>Dog was diagnosed with lymphosarcoma via biopsy of a colon mass. She was euthanized at the owners request after developing sepsis post biopsy surgery.</td>
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</table>
A seven and one half year old, male neutered, Shih Tzu cross was referred for a fluctuant soft tissue swelling in the right maxillary quadrant.

**Diagnosis**

Malocclusion, class three (MAL/3), with unerupted teeth 101, 102, 104, 202, 204, 301, 304, 305, 401, 402, 403, 404 and 405. There were dentigerous cysts extending to and including teeth 101, 102, 103, 104, 105, 106, 107, 201, 202, 203, 204, 205, 206, 207, 301, 302, 303, 304, 305, 306, 307, 308, 401, 402, 403, 404, 405, 406, 407, and 408.

**Clinical findings**

The mandible is longer than the maxilla. Teeth 101, 102, 104, 202, 204, 301, 304, 305, 401, 402, 403, 404, and 405 are unerupted. There was a small amount of calculus on buccal 107, 108, 207, 208, 308, 309, 408, and 409. There were fluctuant areas on the buccal aspect in the area of teeth 104, 204, 304, and 404. These were dentigerous cysts due to unerupted teeth. There was a 5 mm periodontal pocket at the mesial aspect and a grade one furcation exposure of tooth 109. Teeth 311 and 411 were missing.

**Laboratory/Diagnostic/Imaging findings**

Intraoral radiographs were obtained during the procedure. Post-operative radiographs revealed that no root tips were left behind and that the mandible had not been fractured during the surgery.

**Treatment**

*February 17, 2014*

Teeth 101, 102, 103, 104, 105, 106, 107, 201, 202, 203, 204, 205, 206, 207, 301, 302, 303, 401, 402, 403, 404, 405, 406, 407, and 408 were surgically extracted and the cyst lining was surgically removed. Canine Osteoallograft (Periomix – VTS) was packed into the extraction sites on the right mandible and the left maxilla. The right maxilla was not packed with
allograft as the apex of tooth 104 was in the sinus, and the dentigerous cyst was also in
the sinus. The right maxillary area was packed with Bleed-X to control the bleeding in the
sinuses. The surgical flaps were closed with 4/0 monocryl in a simple interrupted pattern.
The remaining teeth were ultrasonically scaled and polished. Tooth 109 was root planed
closed. An injection of Convenia was given subcutaneously. Convenia does not have a
dental claim in Canada but it does in Europe.

March 18, 2014

Teeth 304, 305, 306, 307, and 308 were surgically extracted and the cyst lining was sur-
gically removed. Canine Osteoallograft (Periomix – VTS) was packed into the extraction
sites on the left mandible. The surgical flaps were closed with 4/0 monocryl in a simple
interrupted pattern. Remaining teeth were ultrasonically scaled and polished again as the
owner was instructed not to brush the teeth since the last surgery. Tooth 109 was root
planed closed. An injection of Convenia was given subcutaneously. Convenia does not
have a dental claim in Canada but it does in Europe.

July 15, 2014

Re-examination with radiographs of previous surgical sites. Complete scaling and pol-
ishing of the remaining teeth.

Prescriptions

February 17, 2014

Metacam 1.5 mg/ml (Meloxicam): Give 12 drops by mouth every 24 hours for 7 days
with food.
Tramadol HCL – Give 40 mg by mouth every 8 hours for 3 days with food.

March 18, 2014

Metacam 1.5 mg/ml (Meloxicam): Give 14 drops by mouth every 24 hours for 7 days
with food. (The dog had gained weight since the last surgery).
Tramadol HCL – Give 40 mg by mouth every 8 hours for 3 days with food.

July 15, 2014

None

Comments

This patient was on soft food only for 4 months post-surgery. He was not allowed to
play with other dogs. He was also not allowed anything in his mouth to chew on. The in-
structions read he may have his tongue, remaining teeth, air, water and soft food only in
his mouth for the next 4 months.

These four dentigerous cysts were a result of unerupted 04’s and 05’s and incisors in
the maxilla and the mandible. Dentigerous cysts are invasive and act like locally invasive
tumors disrupting teeth and bone as they grow. Teeth need to have the enamel organ worn
off as they come into wear. If they are unerupted this enamel organ does not wear off and
the enamel organ can secrete fluid as in this case and cause large invasive, disruptive cysts.
This occurs in humans 39% of the time. There is no published canine study. Radiographs

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are required to determine if a tooth is unerupted and if a cyst is developing. The loss of bone in this case is severe and the worst that I have ever seen. Bone graft material was placed in this patient’s jaw to prevent pathological fracture post operatively. The patient’s jaw was very fragile post-surgery.

It is important to always count the teeth as just one unerupted tooth can cause a very large and invasive cyst. The left mandible was dealt with one month later after the first surgery to allow the right mandible time to heal and to form bone in the area of the extraction sites and cyst removal.

Unerupted teeth have a good prognosis with early detection and extraction. They have a fair to guarded prognosis with extensive bone destruction as in this case.
Partial mandibular ramus resection with piezosurgery for peripheral osteoma in a 4 year-old dog

Isabelle Druet¹, P Hennet¹, H Gaillot¹ & L Blond²

1 Advetia Veterinary Speciality Clinic, Paris, France
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A 4-year-old male springer cross was presented for pain on opening of the mouth associated with a left temporal swelling. Initial CT scan showed a slightly heterogenous ossified mass (3.4 cm x 2.4 cm x 2.9 cm) with an irregular contour on the coronoid process. Surrounding soft tissues were normal pre and post contrast. Lymph nodes were not enlarged. Bone biopsy was performed and revealed rather well differentiated osseous tissue with, in periphery of one biopsy, presence of a denser cellular zone constituted of mesenchymal fusiform cells with some atypia and low mitosis rate. The presence of this cell population was considered potentially suspect of low-grade parosteal osteosarcoma. Differentials included multilobular osteochondrosarcoma and osteoma. Chest CT scan did not show evidences of metastasis. Surgery was performed with a piezoelectric osteotome. Zygomatic arch was removed and ramus was resected just above the level of the TMJ. Histology of the bone piece and surrounding muscles were in favour of an osteoma of the coronoid process associated with marked fibrosis within peripheral muscular tissue. No malignant criteria were observed. Healing was unremarkable and the dog returned to complete normal function. 6 months and one-year CT scan follow-up did not show any sign of relapse.

History and clinical examination

«Eclair» a 4 year old male springer cross, living in the south of France and weighting 17 kg was referred to ADVETIA Veterinary Speciality Clinic (Paris) for a swelling of the left temporal area.

The dog did not have any specific medical history. He presented with sudden pain on mouth opening associated with a swelling of the left temporal area and was presented to the local veterinarian. Oral examination did not reveal any abnormality except for pain. Total blood count and biochemical blood parameters were within normal limits. The dog was referred by the GP to a local veterinary hospital to have CT scan performed by a specialist in diagnostic imaging. A slightly heterogenous ossified mass (3.4 cm x 2.4 cm x 2.9 cm) with an irregular contour was identified on the coronoid process. Surrounding soft tissues were normal pre and post contrast. Lymph nodes were not enlarged. Bone biopsy was performed and revealed rather well differentiated osseous tissue with, in periphery of one biopsy, presence of a denser cellular zone constituted of mesenchymal fusiform cells with some atypia and low mitosis rate. The presence of this cell population was considered po-
tentially suspect of low-grade parosteal osteosarcoma. . Differentials included multilobular osteochondrosarcoma and osteoma. Medical treatment was administred (prednisolone 1 mg/kg) to decrease swelling and pain and the dog was referred to Advetia veterinary specialists for surgical treatment. Chest CT scan did not reveal any metastasis.

**Surgical treatment and outcome**

After aseptic preparation of the left temporal area, skin incision was performed over the zygomatic arch. Muscular fascia between temporal muscle (dorsally) and masseter muscle (ventrally) and periosteum were incised, the zygomatic arch was exposed after elevation of the periosteum and muscles both dorsally and ventrally. Osteotomy of the zygomatic arch was peformed with a piezoelectric osteotome (Piezotome2®, Satelec, France). The zygomatic bundle of the temporalis was further reclined dorsally and the masseter reclined ventrally to expose the ramus. The ramus was amputated with the piezoelectric osteotome just above the level of the TMJ. Muscles attaching to the ramus/coronoid process were dissected with electrosurgery and the amputated ramus was removed. After lavage and suction of the wound, the surgical site was closed by suturing together the fascia of the temporal and masseter muscles. The zygomatic arch was not replaced.

Post-operative CT scan was performed to confirm the thoroughness of the resection. The resected piece with muscular tissue was sent to histology. Histologic examination reported a large well delimited tumoral mass composed of well-differentiated osseous tissue. Large anastomosing sheets of bone with an osteoid matrix comprise well-differentiated osteocytes without atypia. Mitotic figures were not observed. In some sections, anastomosing sheets were lined by layer of osteoblastic cells with moderate atypia, which were delimitating a well differentiated adipose or fibrous tissue. These features were in favour of an osteoma.

Healing was unremarkable and the dog returned to complete normal function. 6 months and one-year CT scan follow-up did not show any sign of relapse.
A 15-year old female dachshund “Sarka” was presented in July 2013 for first time for vaccination, owner denied any effort to diagnose and treat present periodontitis and heart murmur. The owner was warned about potential consequences of both conditions if left untreated. 6 months later the dog was presented with history of an acute onset of bleeding from oral cavity, owner found the dog in the morning with no evidence of trauma, but noticed face deformity in the area of lower jaw. The dog was very difficult to examine due to aggressive behaviour. Stage IV periodontal disease was diagnosed with suspected pathologic fracture of the lower jaw. No bleeding was present at the time of presentation. The dog was medicated with antibiotics (amoxicillin-clavulanate 22 mg/kg BID) and non-steroidal anti-inflamatory drugs (carprofen 2,2 mg/kg first day, 1,1 mg/kg BID following days) and scheduled for a surgery. Preoperative blood check showed anaemia (RBC 3,6x1012/l; HGB 7,2 g/l; HCT 25,23 %, MCV 70 fl, MCH 20,1 pg ; MCHC 28,6 g/l (normocytic, slightly hypochromic), which was assumed to be caused by bleeding reported by owner. Serum biochemistry did not reveal any chronic disease explaining hypochromic anaemia, only heart disease was suspected based on the presence of marked systolic heart murmur. Reticulocyte count was not performed as the owner did not wish to, his demand was to fix the fracture. Serum biochemistry show mild elevation in ALT (1,37 ukat/l). The owner did not wish to perform any cardiology examination prior to the fracture repair to assess the anaesthesia risks, but accepted unknown and potentially high risks. The patient was premedicated with fentanyl (10 µg/kg) and acepromazine (0,05mg/kg) i.m. 30 minutes prior to induction (propofol till intubation possible, approximately 4 mg/kg i.v.). Size 5 mm cuffed endotracheal tube was placed, and the patient was connected to breathing circuit, isoflurane gas anaesthesia was delivered with oxygen flow rate 0,5 L/min and isoflurane concentration 1,5%. The patient was delivered continuous infusion of fentanyl in dosage 10 ug /kg/hour and Hartmann solution was used in a rate of 5 ml/kg/hour to maintain blood pressure and perfusion but minimalise the risks of lung oedema due to cardiac disease- mitral valve disease was suspected. Electrocardiogram, end-tidal CO2, indirect blood pressure, temperature and pulse oximetry was monitored with patient monitor and recorded every 10 minutes during the procedure in a protocol. Thermoregulation was supported by a heating pad and covering patient with warm blankets. Antibiotic ointment was used to prevent eye infection.

First of all, oral cavity was desinfected with 0,15% chlorhexidine solution, than examined and results charted. Fracture of mandible with trauma to adjacent soft tissue was
found with instability and crepitus mainly in the distal fracture line. Pronounced periodontitis (stage IV, overall CI 4, PI 4, GI 3) and gingivitis was found. Intraoral dental X-rays were performed, confirming jaw fracture, one fracture line lying between right lower fourth premolar and first molar and second line within the left mandibular canine alveolus. Instability of the fractured mandible fragments was confirmed, in distal fracture line there was marked displacement.

All teeth were scaled and those indicated for extraction due to periodontal disease were removed including fourth right mandibular premolar and right lower canine, which were included in the fracture line, periodontaly were not sound (101, 102, 108, 109, 110, 201, 204, 205, 206, 209, 210, 301, 302, 303, 304, 310, 311, 401, 402, 403, 408), except those intended to use for fixation of the fracture (although both third mandibular premolars - 307,407 - were found with furcation involvement grade 3, but yet they were not mobile and using them for interdental fixation seemed like an only option to fix the fracture in a minimally invasive -intraoral- fashion). Also both teeth involved in the fracture line (fourth right premolar in the distal fracture line and left lower canine in the mesial fracture line), first mandibular right molar was not removed, it was stable, periodontally sound and necessary for fixing the fracture. Extraction wounds were sutured, closure of the lower canine extraction site required flap preparation.

Soft tissue in the distal fracture line was sutured with simple interrupted pattern sutures with monofilament poliglecapron suture material (Glycolon 1,5 EP, Resorba).

Modification of regular method of wiring and acrylate splinting had to be used due to lack of stable teeth (mobile left lower canine, all incisors-all extracted) to stabilise the alveolar fracture line. The fracture was reduced, it was not possible to achieve perfect anatomical reposition. A 0,8 mm orthopaedic wire was used for interdental wiring. A “bridge” was created between right mandibular canine and left second mandibular premolar over the bottom of the oral cavity instead of standard splinting following the dental arch. The wire was placed around right lower canine and through the furcations of the second left premolar in an “eight” shape manner, since they were intended to be extracted after the fracture is healed. Remaining teeth were polished, those intended to be involved in fixation were acid-etched and bis-acrylate (M+W Pontiform Automix) was used to form an acrylic splint. Upper canines were left in situ due to already long duration of anaesthesia (although deep periodontal pockets were found on the palatal side), were treated with closed curettage as a temporary solution and were planned to be extracted later.

The patient recovered with mild tachypnoe, so after the surgery it was hospitalised for 3 days, first to monitor recovery from anaesthesia and then to provide adequate hydration and nutrition support. The dog was medicated with antibiotics (amoxicilin-clavulanate 22 mg/kg initially s.c. once daily, after two days p.o. BID) for 14 days, post-operative analgesia was provided with metamizol 40 mg/kg s.c. every 4 hours, buprenorphin 10 ug/kg i.m. every 6 hours first night after surgery. Non-steroidal antiinflamatory drugs were avoided due to vomiting which occured after surgery and omeprazol i.v. was given TID three days post-operatively. Postoperative care was complicated by aggressiveness of the dog. Due to tachypnoe owner finally agreed with cardiology examination to be performed (chest X-rays, echocardiography with doppler mode use) with findings of cardiomegaly, left atrium enlargement due to moderate mitral insufficiency. Second day after surgery the dog was eating, but had some troubles with drinking, dropping water. Those troubles ceased during next 2 days. The owner agreed with our recommendations and the dog was medicated with benazepril 0.25mg/kg with spironolactone 2mg/kg (Cardalis) once daily two weeks after surgery. After this medication, the dog was more vital according to the owners and an exercise intolerance ceased, which the owner formerly believed was caused by age of the dog.
After releasing Sarka from the hospital owners were instructed to flush the oral cavity twice daily with 0.12% chlorhexidine oral rinse (Cleandent) and add Plaque-Off in the dog meal, drinking additive containing xylitol (Vetaquadent) and use enzymatic oral gel (Orozyme gel) twice daily to reduce plaque formation. Tooth brushing was not expected to be possible due to aggressive behavior of the dog. The tendency to form plaque and dental calculus was precluded due to presence of oral splint and because teeth were left in the oral cavity, which might promote this tendency due to exposed furcations, pockets and other periodontal pathologies.

8 weeks after the initial fracture treatment the dog was scheduled for the splint removal and extraction of rest of indicated teeth. The dog was sedated and anaesthetised in the same manner as during the previous surgery. Intraoral dental radiologic examination was performed which showed signs of healing. In the distal fracture line the calcification in the fracture gap was evident, there were also signs of horizontal bone loss in the place after fourth right lower premolar, which was extracted during the first procedure. The splint was removed gradually- first the bridge between both mandibles was disrupted and then the major part of the fixation, so each fracture line could be inspected for instability before definitive removal of the fixation. Clinically the fracture was stable. Rest of the teeth indicated to was extracted (103,104,306,307,309,404,407) extraction wounds were sutured as during the previous surgery with flap (envelope, advanced) preparations.

The patient recovered uneventfully, dog was drinking the other days but not eating, attempts were made and intravenous nutritional support was provided the first day after surgery, but not any longer due to patient’s aggressive behaviour. Second day after surgery the dog started to eat. Owners were asked to institute the same methods of oral hygiene as after the first intervention (chlorhexidine flushes, enzymatic gel, water and food additive). The dog was medicated with antibiotics (amoxicillin-clavulanate 22 mg/kg BID) for 7 days.

On oral examination 7 days following the second surgery wounds were healing well, there was some erythema evident, so antibiotics were prolonged for 7 more days. Owners were instructed to try cleaning teeth at least with a textile finger-brush while using enzymatic gel instead of toothpaste and eventually after some time try even toothbrush with bristles, maintain recent dental hygiene regular dental and cardiology rechecks were recommended every 6 months. Within this recheck the endodontic status of right first mandibular molar (which mesial root was included in the fracture line) radiologically. Concerning the overall health status of the dog extraction or endodontic treatment might be considered if endodontic infection will be confirmed. Patient is doing fine at the moment, medicated longterm only for his heart disease.
Vladka Strosova

Dentigerous cyst: Is it really a rare diagnosis

Dentigerous cyst is not a frequent finding in the small animal dentistry, particularly if we are not looking for it. Dentigerous cyst is a type of odontogenic cyst with two subtypes, eruption and follicular. Eruption cyst is characterised by dilatation of the dental follicle during tooth eruption, while follicular dentigerous cyst originates in enamel epithelium of an unerupted (embedded or impacted) tooth. The growth of these cysts is very slow and often without any clinical signs therefore the owner doesn’t notice any health issue. The size of dentigerous cyst varies case to case. Some cysts are very discrete but some are huge and destructive due to massive bone lysis. These lesions are usually painless, the only clinical sign can be mild or more visible swelling in the missing tooth area. Dentigerous cyst is very often created in unerupted premolars and canines, especially in mandibular area. Brachycephalic and toy breed dogs are more frequently affected, one case noticed dentigerous cyst in deciduous canines in a cat.

This presentation wants to show on three clinical cases, how important routine X-Ray examination is in “routine” dental treatment. All these cases were presented not because of dentigerous cyst suspicion, but for another dental disease. In one case the cyst was large and segmental hemimandibulectomy was performed.

Introduction

Odontogenic cysts originate from various dental structures. These cavities are lined with epithelium and contain fluid, mucus and there can be also some tissue material. Odontogenic cysts are classified by their origin in primordial cyst, dentigerous cyst and gingival cyst. There are two subtypes of dentigerous cysts. Eruption cyst is fluctuating swelling around the tooth crown of the normally erupting tooth. They are presented with no or mild clinical signs like pain during eruption phase. Follicular cyst is a space around the tooth, which is unerupted. The cyst line originates from the rest of the enamel organ and is attached in the tooth neck area. The cyst is not developed in every unerupted tooth and in every breed but brachycephalic and toy breed (boston terriers, pugs, chihuahuas etc.) are more affected.

Enamel organ is formed during embryonic stage. Ectodermal oral epithelium changes into the dental lamina. Dental lamina forms invaginations and enamel organ develops. During stages called bud, cap and bell the inner and outer enamel epithelium, stratum in-
termedium and stellate reticulum develop. On the mesoderm side there are created dental papillae. Preameloblasts in inner enamel epithelium differentiate into the ameloblasts and produce organic enamel matrix. The enamel thickens towards basal line and odontoblasts. Inner and outer enamel epithelium is pressed together, stellate reticulum disappears and one layer called Nasmyth’s membrane is created. Nasmyth’s membrane protects the tooth crown during eruption phase and it completely disappears when the tooth penetrates the gum line. When the tooth doesn’t erupt, Nasmyth’s membrane remains intact and the dentigerous cyst can develop. The fluid (transudate or modified transudate) accumulates under the Nasmyth’s membrane and separates the tooth crown from this protective layer. The fluid changes its character in time to exudate and it causes larger cyst expansion. In the cyst there can be not only the unerupted tooth, but also roots of the other teeth. These roots can be damaged by resorptive process, can be rotated or completely dissolved.

The diagnosis is highly suspicious on X-Ray examination. Smooth shaped radiolucent area around unerupted tooth is the most likely diagnosis of dentigerous cyst. On the other hand there can be potential risk of neoplastic transformation and histopathological examination is recommended.

Treatment of dentigerous cyst can be very easy and uncomplicated when the cyst is small in size. It is necessary to extract the unerupted tooth and completely remove the whole rest of Nasmyth’s membrane. The best option is surgical extraction. Larger cysts can nearly touch the roots of other teeth and the work with a drill must be very careful. Some cysts are huge, contain more roots and destruct cortical bone of the jaw. This can lead to pathological fracture. These huge defects often require radical stomato-surgical procedure.

Patient monitoring after the dentigerous cyst treatment is necessary because of potential cyst recurrence and damage of neighbouring teeth during procedure and is recommended in 12 (24) months.

Case 1

Boston terrier, 5y. old, male, 11 kg. This dog was trained for flyball and was presented for occasional bleeding from the mouth during exercise with the tennis ball. The dog was in good general health condition, regularly vaccinated, without any other anamnestic complains. Physical examination revealed complicated fracture of 206 (or 207) with total crown loss and severe focal gingivitis with gingival bleeding. It was assumed that it is the cause of the client’s worries. Physical examination also revealed a lot of missing teeth – 207 (206), 305, 311, 405, 407 (408?), 410 and 411. During oral examination there was no visible swelling of the jaw (PE was little bit limited according to the dog’s temperament). The decision was to make one extraoral X-Ray oblique laterolateral projection in analgesedation to view roots of the fractured tooth and verify absence of all missing teeth. Extraoral radiograph showed both retained roots of the fractured premolar tooth and also a lot of unerupted teeth and impacted teeth 305 and 405 with large radiolucent areas in the rostral part of the mandible. According to this finding were made few intraoral X-Ray projections to assess the size of the defect. Retained roots of the fractured premolar were extracted following radiography, the wound was sutured and the diagnose of the suspicious bilateral dentigerous cyst was explained to the owner. In the left hemimandible the cyst contained roots of the canine and second premolar, in the right hemimandible the cyst was larger, it extended from canine to the third premolar. On the both sides there was massive alveolar and cortical bone lysis. No exercise and soft food was recommended until the treatment will be performed. On the left side all affected teeth were extracted with curettage of the cystic line. The wound was sutured by simple interrupted pattern using mucoperiosteal
flap. On the right hemimandible the bone defect was larger and the cortical bone in the area of the teeth 404-406 was very thin and soft. Partial hemimandibulectomy in the range of 403 – 407 was performed. The correction of the size of the lower lip was done using “V-shape” technique and sutured in three layers. Part of the mandible with impacted tooth 405 was sent for histopathological evaluation, which confirmed the diagnosis of dentigerous cyst. The patient was medicated with antibiotics, analgetics and soft food was recommended for one week. No toys were allowed for 14 days. No complication were observed at 10 days check up and the dry food was slowly offered. Plastic foam ball was recommended as a good way to play with and to slowly exercise the jaws. Next X-Rays examination was planed in 6 months.

**Case 2**

Small schnauzer, male, 5y. old, 4,8kg, was presented for periodontal treatment. The owner’s main complains were halitosis and large amount of calculus. Dental examination under general anaesthesia revealed severe parodontopathy in teeth 108, 109,209, 309, 311 and 410. Periodontal pockets (4-6mm), mobility (M2-3), furcation FI3 were the main pathological findings. Teeth 305 and 405 were missing. Full dental radiograph was made and severe parodontopathy was confirmed by the presence of numerous periapical granulations/ abscesses. The diagnosis of bilateral dentigerous cyst was based on the presence of unerupted teeth 305, 405 with typical radiolucent area around these teeth. Cysts were small in size and affected only mesial roots of the second premolars. Extractions of the affected teeth and periodontal treatment were performed. Dentigerous cysts were treated by surgical extraction of the first and second premolars, a thorough curettage of the rest of enamel epithelium and suture the mucoperiosteal flap by simple interrupted pattern. The patient was at home medicated with antibiotics and analgetics and the reconvalescence was without any complication.

**Case 3**

Pug, female neuter, 4y.old, 7kg, was examined for mild halitosis and calculus (CI1-2). There was also presence of deciduous tooth 703 and absence of 305 and 405. In the age of 12 months the dog was neutered and in the same time the veterinarian extracted some deciduous incisors and canines without making any dental X-Rays. Intraoral X-Rays were made under general anaesthesia.

Teeth 305 and 405 were present in the mandible and there was small radiolucent area around 405 touching the distal root of 406. Diagnosis of dentigerous cyst was highly suspected and surgical extraction of 405 and 406 was performed. Tooth 305 was also extracted. All teeth were cleaned and polished and the dog was medicated with antibiotics and analgetics for 5 days.

**Conclusion**

The diagnosis of the dentigerous cyst is limited, because of its very mild (if any) clinical signs, slow growth and low awareness in owner and vets community. If the animal has any tooth missing at the age of 7 (8) months and more, it worthwhile to verify its presence or absence in the jaw radiographically. Useful is to make X-Rays during another procedure, when is the animal sedated or in general anaesthesia. It is better to prevent cyst formation than to treat them and is better to treat small defects than huge holes.
An adult male Barbary Macaque \textit{(Macaca sylvanus)} from Stichting AAP, rescue center for exotic animals in the Netherlands was presented with severe mucopurulent conjunctivitis/dacrocystitis considered related to common cold. The history of earlier extractions of decayed teeth did not indicate a dental cause at first and initially treatment with broad spectrum antibiotics was started. As the symptoms aggravated, additional tests were performed and a sinusitis maxillaris was diagnosed. After culture the therapy appeared to be targeted at a resistant flora of bacteria. Finally, during surgery a remnant of a molar was discovered in the maxillary sinus hardly recognizable on special X-ray and showed itself in an unexpected location.

Only few articles show apical or dental reasons for developing orbital disease, mostly in human and felines. This is the first case report of a non-human primate species with similar abnormalities. This case shows the necessity for better understanding of the close relationship between the maxillary dental arcade, the sinuses and nasolacrimal duct in this species. Considering the current trend to use antibiotics, obtaining more sensitive diagnostics like dental X-ray and CT might be a solution.

This presentation will show solutions for diagnosing dental related orbital disease in non-human primates.
The aim of the present study is to evaluate retrospectively the prevalence, localization, treatment and outcome of oral tumors in dogs.

Medical records of the Companion Animal Clinic from 2001 to 2014 were searched for dogs with histologically confirmed oral tumors. Fifty-four from 70 dogs with oral tumors were included in the study. The age distribution was between 5-months to 17-years. Male dogs were more frequently affected (55%). Fifty-seven percent of the tumors were malignant including melanomas, undifferentiated pleomorphic sarcomas, fibrosarcomas, osteosarcomas, squamous cell carcinomas, and a multilobular osteochondrosarcoma, hemangiosarcoma and a cystic basal-cell carcinoma.

Benign tumors identified as epulides (acanthomatous, fibrous and ossifying epulides), viral papillomatosis and central giant cell granuloma. There was no breed predilection, but boxers, cocker spaniels and German shepherds were over presented. The gingivae were the most common site of appearance (84.9%) - mainly mandibular gingiva -, although the buccal or labial mucosa, hard and soft palate and tongue were also affected.

Oral radiographs obtained during general anesthesia showed apparent bone lysis in 14 of 22 cases. Difficulty or reluctance to eat and excessive salivation that may be blood tinged were the main reason of admittance. Partial mandibulectomy or maxillectomy, hemimandibulectomy or regional resection of the tumors was the treatment of choice.

Six tumors were non amenable to surgery, while lymph-node resection was performed in 4. Local recurrence was reported in 12 cases 1 to 12 months after initial treatment. Twenty-one out of 52 dogs survived more than 6 months.
Objective – To characterize osteonecrosis of the jaws (ONJ) in previously irradiated fields in dogs that underwent radiotherapy (RT) for oral tumors. Osteoradionecrosis of the jaw (ORNJ) was further defined as osteonecrosis in a previously irradiated field in the absence of a tumor.

Design – Retrospective case series.

Animals – Thirteen dogs clinically diagnosed with fifteen ONJ lesions.

Procedures – Medical records were reviewed for: breed, sex, weight, and age of the patient, tumor type, location in the oral cavity and size, location of the ONJ, time from RT to ONJ onset, known duration of the ONJ, and tumor presence. Where available, histological assessment of tissues obtained from the primary tumor, and tissues obtained from the ONJ lesion, was performed, and computed tomographic (CT) images and dental radiographs were reviewed. Radiotherapy and other treatment details were also reviewed.

Results – Twelve dogs developed ONJ in the area of the previously irradiated tumor or the jaw closest to the irradiated mucosal tumor. Recurrence of neoplasia was evident at the time of ONJ diagnosis in five dogs. Time from RT start to ONJ onset varied from 2 - 44 months. In three cases, ORNJ developed after dental extractions in the irradiated field. Dental radiographs mostly revealed a moth-eaten pattern of bone loss, CT mostly revealed osteolysis, and histopathology was consistent with osteonecrosis.

Conclusions and clinical relevance – Development of ONJ/ORNJ following RT is a rare, but potentially fatal complication. Patients undergoing RT may benefit from a comprehensive oral and dental exam and treatment prior to RT.
RANKL, OPG, Ccl2 and VEGF mRNA expression in odontogenic and non-odontogenic canine oral tumors

Ana Nemec¹,³, Clare Yellowley², Boaz Arzi³, Alice Wong², Brian G. Murphy⁴, Philip H. Kass⁵ & Frank J.M. Verstraete³

Objective – To evaluate if non-odontogenic canine oral tumors express more pro-resorptive factors and/or are associated with more inflammation as compared to odontogenic tumors.

Sample – Eight odontogenic (4 peripheral odontogenic fibromas [POF], 4 canine acanthomatous ameloblastomas [CAA]) and 7 non-odontogenic (3 malignant melanomas [MM], 2 squamous cell carcinomas [SCC], 1 osteosarcoma [OSA], 1 fibrosarcoma [FSA]) tumors were included in the study.

Procedures – Sample sections stained with hematoxylin and eosin were evaluated for presence and amount of tumor-associated inflammation (TAI). Quantitative PCR analysis was performed for each tumor and mRNA expression of RANKL, OPG, Ccl2 and VEGF evaluated.

Results – The level of TAI seemed higher in non-odontogenic tumors and this difference was close to statistically significant (P = 0.074). Odontogenic tumors expressed more RANKL and OPG mRNA compared to non-odontogenic tumors. However, this difference was not statistically significant. RANKL:OPG ratio was similar for both groups of tumors. Odontogenic tumors expressed less Ccl2 and VEGF compared to non-odontogenic tumors, but the difference was not statistically significant. Tumors with TAI present in > 5% of the stroma expressed significantly (P = 0.0031) more Ccl2 compared to tumors with less or no inflammation. RANKL, OPG and VEGF expression did not differ in association with TAI.

Conclusion and clinical relevance – This study confirms that odontogenic and non-odontogenic canine oral tumors express mRNA of several bone turnover, inflammatory and angiogenic factors. Production of these factors, however, does not differ between the odontogenic and non-odontogenic oral tumors and is therefore not likely associated with their biologic behavior.

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Recovery of dogs after radical surgery of the jaw

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Introduction

Oral neoplasms are challenging due to problematic in-time diagnosis and treatment. If the client does not check the dog’s oral cavity regularly, the disease is revealed accidentally or even after the onset of gross symptoms. These include hypersalivation, bleeding, halitosis and sometimes facial asymmetry. Anorexia is more common in progressive stages of the disease. Unfortunately, some clients present the patient first after occurrence of food intake disorders. In such a progressive disease, the therapy becomes difficult and prognosis cautious to poor. It is not easy to get the client’s agreement with appropriate diagnostic and therapeutic procedures even in the early presented cases. Nevertheless, radical surgery (i.e. complete tumour removal with a healthy tissue margins) is one of important prerequisites if the therapy should be successful. In many cases, this procedure requires partial or complete jaw removal. The later the tumour is diagnosed and treated, the lower the success rate is.

In practice, the extensive oral surgery takes sometimes less time than to persuade the client that it is the most beneficial option for the pet. The main concern often is: Will the dog ever recover after the surgery? And if so, how long would it take?

Material and methods

Patients included in this study were treated at the Department of Surgery of the Small Animal Clinic between 1st January 2006 and 30th February 2010. There were 2712 dentistry patients (dogs) in total. Oral neoplasia was diagnosed and radically surgically treated in 123 dogs. All types of oral neoplasia were included, disregarding any later pathohistological findings. The patients’ condition before and after the surgery were recorded as well as the course of recovery in one month after the procedure. Any oncological complications which occurred later were not considered. Check-ups was performed 2, 7, and 30 days after the surgery. Owners were instructed to observe and record the dogs’ will and ability to eat and presence of any behavioural changes with their progress (e.g. reluctance to play, lethargy etc.). Based on these data, approximate recovery period for each type of extensive oral surgery was determined.
Results

Clinical records showed that the length of recovery period depends not only on the extension of the procedure; postoperative analgesia played an important role. The dogs were assigned to following recovery groups:

Mandible, 0 – 3 days: Surgery not involving extensive part of the mandibular body (rim excision, unilateral rostral mandibulectomy preserving at least part of the symphysis).

Mandible, 4 – 7 days: Surgery removing tissue amount comparable to one lower jaw (mandibulectomy, bilateral rostral mandibulectomy).

Mandible, 8 – 12 days: Loss of tissue equal more than one mandibular body (3/4 mandibulectomy), patients suffering intense pain.

Maxilla 0 – 3 days: Limited extension surgery, mesial to 108/208.

Maxilla 4 – 7 days: Surgery caudal to 108/208 (incl.), involvement of canalis infraorbitalis and/or eye socket.

None of the treated patients had any long-term complications, none of them had to be euthanized due to poor recovery or postoperative adaptation.
Purpose of research: Marine mammal species are a useful indicator of near-shore ecosystem health and commonly remain in one geographical location for most of their lives. Their ecology, diseases and causes of death have been extensively studied. However, dental disease and temporomandibular joint (TMJ) disease have until recently received little attention. The aim of the present study was to describe the gross osteological findings associated with TMJ osteoarthritis (OA) in 3 common marine mammal species.

Study methodology: Museum skulls specimens of stranded southern sea otters (n=1,008), California sea lions (n=495) and northern elephant seals (n=104), were examined macroscopically according to defined criteria for the presence, severity and characteristics of TMJ-OA.

Results: Overall 4.1% of the southern sea otters and 63.5% of the California sea lions specimens had findings consistent with TMJ-OA. There was no significant association between age and sex with the presence or severity of TMJ-OA. The most prominent TMJ-OA changes were the presence of subchondral bone defects, increased porosity of the articular surface and peri-articular osteophytes. Both the condylar process of the mandible and the mandibular fossa were affected. In northern elephant seals there were 3 cases of bony defects in the mandibular fossa, consistent with osteochondritis dissecans.

Conclusion: TMJ-OA occurs in southern sea otters and northern elephant seals but the incidence in California sea lions is particularly high. Although the significance of the high incidence of this disease in the latter species remains elusive, the occurrence and severity of TMJ-OA detected in this study may play an important role in the species’ morbidity and mortality.

Reference list


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Full-mouth radiographs in guinea pigs and chinchillas

Dental diseases in gp & chinchillas are a common reason presenting them to the veterinarian. Even with a good clinical examination, probing and the standard extraoral radiographs in different views including reference lines some of the pathology will be missed. With the introduction of innovative image plate CR-Scanner for all small formats in veterinary medicine the technical limitations for intraoral radiographs in rabbits are solved. This lecture will discuss, whether this technique is transferable to gp & chinchillas and the limitations with intraoral radiographs in these species.

References


Ferrets, rabbits and rodents are very common household pets in Europe as well as in the United States. With increasing popularity, the complexity of diagnostic and surgical procedures performed in small pet mammals is increasing. Nowadays, many types of anaesthetic regimes were described—including using of drugs that are injected intravenously or intramuscularly or inhalant anaesthetics. Patient should be monitored throughout the surgical procedure with all necessary perioperative care. Based on authors’ experience, rabbits and rodents are at the same risk of anaesthesia that dogs and cats; the anaesthetic regime must be based on the health of a small exotic pet mammal and type of surgical procedure to be performed. Moreover, practitioner and nurse should be familiar with the particular species and his anatomy, physiology and other specific needs. The aim of this paper is to describe step by step pre-, peri- and postanaesthetic care of selected small exotic pet mammals, full anaesthetic and analgesic drug dosages included.

A thorough history of current and past medical problems can provide valuable information about small mammal health status. Physical examination may reveal pale mucosal surface, abnormalities of the heart or lungs, abdominal masses or other pathologies that may require further evaluation such as a haematological and plasma chemistry examination, urinalysis, radiography, electrocardiogram, echocardiography or any other diagnostic method prior to performing general anaesthesia. Thorough physical examination is therefore very important in establishing further diagnostic and anaesthetic plan. Based on clinical examination, laboratory analyses and results of imaging methods is patient placed in appropriate ASA physical status scale (class I – V). In dependence of the ASA-group an additional examination should be performed and/or patient life functions must be stabilised before any anaesthesia or sedation. Even when a rabbit is placed in ASA I-II, author recommends ensuring intravenous access.

Animal should be properly weight and all drug dosages should be calculated carefully. In case of intramuscular injectable drugs with potential pain effect (e.g. ketamin) or in case of larger volumes, the agent should be administered to more places to avoid any necessary pain. Intraperitoneal anaesthetic administration is not recommended. The anaesthesiologist should monitor anaesthetic depth and all the vital signs to keep the rabbit safe and in appropriate surgical plane. The objectives of surgical anaesthesia (stage 3, plane 2) are that patient does not feel pain, is not moving, is not aware, have no memory of the procedure afterward and all the vital signs are not dangerously depressed. Anaesthesia is achieved
when there is a loss of sensation to either a part or all of the body. General anaesthesia also renders the patient unconscious. Sedation is similar to general anaesthesia but the patient remains semi-conscious. Careful attention to intraoperative care is an important contributory factor to successful anaesthesia.

**Respiration**

Due to small thoracic cavity, rabbits and rodents should be placed in position in which is ensured the ability of the lungs to be fully expanded. Respiration is monitored by observing chest movements or by monitors detecting inspiration and expiration. A rise in respiratory rate during anaesthesia is mainly caused by a reduction of a depth of anaesthesia. A fall of respiratory rate below 40 % of the patient’s normal rate (30-60 breaths/minute for rabbits) indicates respiratory failure. If the animal is not intubated, it is necessary to intubate him when anaesthetic monitoring showing signs of cardiovascular or respiratory failure. The airways should be inspected for obstruction and oxygenation together with assisted ventilation should be started. Doxapram is additionally administered. The pressure of assisted ventilation should never be greater than 8 mmHg.

Capnography measure the amount of carbon dioxide in the air that is breath in and out. The patient “end-tidal” CO2 refers to the amount of CO2 measured at the end of expiration and it is used for the estimation of arterial carbon dioxide partial pressure. A side stream capnograph is located between the breathing circuit and endotracheal tube to minimise the dead air space.

Supplemental oxygen, which maximises cardio and pulmonary efficiency, should be provided in all cases of sedation or anaesthesia. In general a flow rate of 200 ml/kg/min will provide an inspired oxygen concentration of at least 40 %. Double flow rate could increase inspired oxygen concentration up to 80 %. Humidifying and warming the oxygen is optimal.

Monitoring of cardiovascular function and circulation includes palpation of peripheral pulse to determine rate, rhythm and quality, and evaluation of mucous membrane colour and capillary refill time (CRT). Auscultation of heart beat, pulse oximetry and ECG are used to grossly assess of peripheral perfusion and heart function. The indirect blood pressure measurement is most commonly used. The ultrasonic Doppler flow detector makes audible blood flow in an artery distal to the blood pressure cuff. The mean arterial pressure (MAP) should be kept above 60 mmHg and systolic pressure above 90 mmHg to ensure adequate organ perfusion. A pneumatic cuff is usually placed on the shaved area above the elbow in a bed of ultrasonic gel and taped in place. Conjunctiva and gingiva should have a pink colour. CRT is best to measure on the gingiva dorsal to the incisors and should be no more than 1-1.5 sec.

Pulse oximetry is a non-invasive continuous measurement of oxygen saturation in tissues. A Sp02 greater than 91% usually indicates adequate oxygenation, however pulse oximetry may be inaccurate by as much as 5%, so the Sp02 level should be kept above 95%. Pulse oximetry fails to detect hypoventilation, hyperventilation or other respiratory problems; capnography is necessary to detect these changes. Pigmented skin could make the reading variable. A quality signal may be unobtainable in patients in hypothermia and hypotension.

Inhalant agents are naturally hypotensive, and untoward effects are dose dependant. The use of inhalant agents as sole anaesthetics necessitates higher doses with increasing the risk of potential adverse effects. Therefore, the use of analgesia and injectable premedication is recommended. It was reported, that use of medetomidine often demonstrates a profound negative impact on the cardiovascular and respiratory system and should be
used with caution. If hypotension occurs during the surgery, the inhalant anaesthesia is reduced first, while the continual rate infusion is increased.

Intravenous (IV) catheter is placed in lateral ear vein, cephalic or saphenous vein. Before catheter placement a layer of EMLA is applied to provide local anaesthesia. Administering perioperative fluids subcutaneously or intraperitoneally is unreliable due to peripheral and visceral vasoconstriction. Intraosseous administration is an alternative to IV access.

Fluid therapy is an important component of haemodynamic stabilisation minimising drug-exacerbated hypotension and risks related to anaesthesia. Perioperative fluids are given via precise syringe pumps. A dosage rate for perioperative IV fluid therapy is 10-15 ml/kg/hour. In case of gastric dilatation, fluid administration into saphenous vein should be avoided.

Recommended first line therapy for hypotension are IV boluses of polyionic fluids of 5-15 ml/kg. Overhydration should be avoided. If a rabbit is refractory to isotonic crystalloid therapy, the use of synthetic colloids should be considered. Hetastarch is administered at 5 ml/kg/IV over 5 to 10 minutes. Another possibility is to use 7.5% hypertonic saline in 1-3 ml boluses over 10 minutes until normal heart rate and blood pressure are obtained. Dopamine or norepinephrine can be used to treat refractory hypotension. Checking glycaemia, PCV, total protein and blood gas analysis intraoperatively is recommended.

**Blood loss**

Blood losses less than 10 % of blood volume in a patient with normal PCV could be corrected with isotonic fluids at a rate of three times the estimated blood loss amount. In case of chronic (PCV <20-25%) or acute blood loss, transfusion of whole blood is recommended. Synthetic colloids should be also added to the crystalloid therapy in rabbits with hypoproteinaemia. Rabbit clinical examination and laboratory analyses are important in determination whether is animal suitable as a donor and for calculation proper amount of blood needed for a recipient. Rabbits have four blood groups; however no problems in the first transfusion were noted by the author. The major cross-match is optimal. The estimation of the amount of whole blood required by the recipient can be calculated as weight (lbs) × 30 × desired PCV - recipient PCV/donor PCV. Whole blood is administered by syringe pump or in boluses into the IV catheter or intraosseously. The haematocrit and total plasma protein concentration should be evaluated 1, 2 and 24 hours post-transfusion. Blood transfusions should be administered within 4-6 hours to prevent the bacterial overgrowth.

The most common method of monitoring temperature is with the use of a rectal thermometer. Heat loss occurs by convection, radiation, conduction and evaporation. Rabbits lose heat rapidly because of their high surface area relatively to their bodyweight. Use of heating blankets/pads set at specific temperature (35-37°C) is strongly recommended. Also fluid and oxygen should be pre-warmed. Using heating infusion devices is recommended.

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**Drug dosages used by article authors in selected small exotic pet mammals. Please note, that the optimal dosages need to be adjust based on a current clinical status of the animal.**
Table 1: Diazepam and midazolam dosages used for sedation of selected small mammals.

<table>
<thead>
<tr>
<th></th>
<th>Ferret</th>
<th>Rabbit</th>
<th>Guinea pig</th>
<th>Chinchilla</th>
<th>Rat</th>
<th>Prairie dog</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diazepam *</td>
<td>0.05-0.10</td>
<td>0.20-0.50</td>
<td>0.30-1.00</td>
<td>0.20-0.40</td>
<td>0.50-1.50</td>
<td>0.40-0.60</td>
</tr>
<tr>
<td>Midazolam *</td>
<td>0.05-0.15</td>
<td>0.05-0.10</td>
<td>0.30-1.00</td>
<td>0.20-0.40</td>
<td>1.00-2.00</td>
<td>0.30-0.50</td>
</tr>
</tbody>
</table>

* Dosages expressed in mg/kg

Table 2: Acetylcholine receptor antagonists used in small mammals.

<table>
<thead>
<tr>
<th></th>
<th>Ferret</th>
<th>Rabbit</th>
<th>Guinea pig</th>
<th>Chinchilla</th>
<th>Rat</th>
<th>Prairie dog</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atropin *</td>
<td>0.05</td>
<td>0.80-1.00</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Glykopyrolatet *</td>
<td>0.01</td>
<td>0.01-0.02</td>
<td>0.01-0.02</td>
<td>0.01-0.02</td>
<td>0.01-0.02</td>
<td>0.01-0.02</td>
</tr>
</tbody>
</table>

* Dosages expressed in mg/kg

Table 3: Recommended intramuscular premedication and induction for selected small exotic pet mammals followed by isoflurane.

<table>
<thead>
<tr>
<th></th>
<th>Ferret</th>
<th>Rabbit</th>
<th>Guinea pig</th>
<th>Chinchilla</th>
<th>Rat</th>
<th>Prairie dog</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medetomidin #</td>
<td>0.01-0.02</td>
<td>0.02-0.10</td>
<td>0.05-0.20</td>
<td>0.02-0.10</td>
<td>0.05-0.20</td>
<td>0.10-0.30</td>
</tr>
<tr>
<td>Ketamine *</td>
<td>2.00-5.00</td>
<td>5.00-15.0</td>
<td>5.00-15.0</td>
<td>1.00-10.0</td>
<td>1.00-15.0</td>
<td>3.00-10.0</td>
</tr>
<tr>
<td>Midazolam *</td>
<td>0.10</td>
<td>0.20-0.30</td>
<td>0.25</td>
<td>0.25</td>
<td>0.20-0.50</td>
<td>0.20-0.50</td>
</tr>
<tr>
<td>Butorphanol *</td>
<td>0.10</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
<td>0.50</td>
<td>0.30</td>
</tr>
</tbody>
</table>

# Dosages expressed in mcg/Kg; * Dosages expressed in mg/kg

Table 4: Recommended total intramuscular anaesthesia for selected small exotic pet mammals.

<table>
<thead>
<tr>
<th></th>
<th>Ferret</th>
<th>Rabbit</th>
<th>Guinea pig</th>
<th>Chinchilla</th>
<th>Rat</th>
<th>Prairie dog</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medetomidin #</td>
<td>0.04-0.05</td>
<td>0.04-0.15</td>
<td>0.08-0.25</td>
<td>0.05-0.10</td>
<td>0.08-0.20</td>
<td>0.10-0.25</td>
</tr>
<tr>
<td>Ketamine *</td>
<td>3.00-10.0</td>
<td>5.00-15.0</td>
<td>5.00-15.0</td>
<td>5.00-10.0</td>
<td>5.00-20.0</td>
<td>3.00-15.0</td>
</tr>
<tr>
<td>Midazolam *</td>
<td>0.15-0.25</td>
<td>0.20-0.40</td>
<td>0.30-0.60</td>
<td>0.30-0.40</td>
<td>0.20-0.30</td>
<td>0.20-0.50</td>
</tr>
<tr>
<td>Butorphanol *</td>
<td>0.10</td>
<td>0.30-0.40</td>
<td>0.30-0.40</td>
<td>0.30-0.40</td>
<td>0.50</td>
<td>0.30</td>
</tr>
</tbody>
</table>

# Dosages expressed in mcg/Kg; * Dosages expressed in mg/kg

Table 5: Analgesic drugs used in selected small exotic pet mammals.

<table>
<thead>
<tr>
<th></th>
<th>Ferret</th>
<th>Rabbit</th>
<th>Guinea pig</th>
<th>Chinchilla</th>
<th>Rat</th>
<th>Prairie dog</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butorphanol #</td>
<td>0.05-0.10</td>
<td>0.20-0.60</td>
<td>0.20-0.50</td>
<td>0.20-0.50</td>
<td>0.20-1.00</td>
<td>0.20-0.50</td>
</tr>
<tr>
<td>Buprenorphin *</td>
<td>0.01-0.03</td>
<td>0.01-0.05</td>
<td>0.05-0.10</td>
<td>0.05-0.10</td>
<td>0.05-0.10</td>
<td>0.05-0.10</td>
</tr>
<tr>
<td>Meloxicam *</td>
<td>0.20-0.30</td>
<td>0.20-0.80</td>
<td>0.20-0.60</td>
<td>0.20-0.60</td>
<td>1.00-2.00</td>
<td>0.20-0.60</td>
</tr>
<tr>
<td>Carprofen *</td>
<td>2.00-5.00</td>
<td>2.00-5.00</td>
<td>2.00-5.00</td>
<td>2.00-5.00</td>
<td>2.00-5.00</td>
<td>2.00-5.00</td>
</tr>
<tr>
<td>Tramadol *</td>
<td>5.00</td>
<td>5.00-10.0</td>
<td>5.00-10.0</td>
<td>5.00-10.0</td>
<td>5.00-10.0</td>
<td>5.00-10.0</td>
</tr>
</tbody>
</table>

# Dosages expressed in mcg/Kg; * Dosages expressed in mg/kg
Acknowledgements

This paper was supported by specific research of the Faculty of Veterinary Medicine, University of Veterinary and Pharmaceutical Sciences Brno, Czech Republic (2014/2015) and by the project IGA No. 114/2013/FVL.

Further reading

A hedgehog is any of the spiny mammals of the subfamily Erinaceinae, which is in order Erinaceomorpha. There are seventeen species of hedgehog found through parts of Europe, Asia, Africa and New Zealand (by introduction). The most common pet species of hedgehog are hybrids of the white-bellied hedgehog (*Atelerix albiventris*) and the North African Hedgehog (*A. algirus*). It is smaller than the European hedgehog and thus is sometimes called the African pygmy hedgehog. In Europe the most common species is (*Erinaceus roumanicus*) have a dental formula of: I3/2 C1/1 P3/2 M3/3. Although traditionally classified in the now abandoned order Insectivora hedgehogs are not exclusively insectivores but are almost omnivorous.

<table>
<thead>
<tr>
<th>Pathology</th>
<th>No. of hedgehogs</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tonsillitis</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>Oral and maxillofacial tumor</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>Periapical abscess</td>
<td>3</td>
<td>1.7</td>
</tr>
<tr>
<td>Jaw fracture</td>
<td>4</td>
<td>2.2</td>
</tr>
<tr>
<td>Nasal/oral coexisting problem</td>
<td>5</td>
<td>2.8</td>
</tr>
<tr>
<td>Teeth fracture</td>
<td>6</td>
<td>3.4</td>
</tr>
<tr>
<td>Gingival enlargement</td>
<td>10</td>
<td>5.6</td>
</tr>
<tr>
<td>Foreign bodies</td>
<td>6</td>
<td>10.5</td>
</tr>
<tr>
<td>Oral mucosa ulceration, necrosis</td>
<td>50</td>
<td>28.1</td>
</tr>
<tr>
<td>Periodontal disease</td>
<td>75</td>
<td>42.1</td>
</tr>
<tr>
<td><strong>Performed procedures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oral prophylaxis</td>
<td>106</td>
<td>59.6</td>
</tr>
<tr>
<td>Extractions 1-4 teeth</td>
<td>63</td>
<td>35.1</td>
</tr>
<tr>
<td>Extractions &gt; 4 teeth</td>
<td>10</td>
<td>5.6</td>
</tr>
</tbody>
</table>

The foundation “Save the Hedgehogs” has been in existence for several years and Veterinary Clinic Arka takes care about rescued hedgehogs in the area. Emergency problems are mostly due to car accidents, burns and dogs attacks. Apart from that, hedgehogs with other problems are also treated, managed and then released to wild or kept in hedge-
The population of 179 hedgehogs: Northern white-breasted hedgehogs (*Erinaceus roumanicus*) and European hedgehog (*Erinaceus europaeus*) were examined and all of them underwent general anesthesia. Two species had ratio 51/49 respectively. Among them there were 51.5% males and 48.5% females. Estimated age was between 3 months and 6 years, (mean =1.2 year). Body weight was between 460g and 2180g (mean = 981.3g); Anesthesia was performed with the use of medetomidine, butorfanol and ketamine. All anesthetized animals received supplemental oxygen. Oral examination underwent all individuals and radiography only selected hedgehogs. Diagnosed pathologies and performed dental procedures in 179 hedgehogs are presented in table. Number one clinical oral problem diagnosed in hedgehogs is periodontal disease. Other oral diseases included: oral mucosa diseases, foreign bodies, gingival enlargement teeth fractures, nasal problems with dental origin, jaw fractures, periapical abscess tumors and tonsillitis. 59.6% of hedgehogs underwent oral prophylaxis procedures with scaling, polishing and root planning if required. Extraction of several teeth was distinguished form hedgehogs which had multiple extractions. From 179 individuals 15 received another dental prophylaxis in perspective of 8 months-1.5 year.
A young rabbit of 1 year was presented for bilateral facial abscess of lower jaws. Several attempts of curettage didn’t achieve control of the inflammatory process. Radical surgery was performed in regard to Cone Beam panoramic description of dental lesions. Following extensive surgical extractions, both abscess healed without any complication. A follow up of two years permit with appropriate Cone Beam examinations to evaluate the future of dental disease in this patient.
Empyema of the nasal conchal bulla as a cause of chronic unilateral nasal discharge in the horse

Padraic Dixon, T. Froydenlund, Tiziana Luiti, J. Kane-Smyth, Apryle Horbal & Richard Reardon

Most cases of unilateral nasal discharge in horses are caused by sinusitis, sometimes caused by cheek teeth apical infection or less commonly by a sino-nasal fistula (secondary to cheek teeth diastema). Endoscopy of the middle nasal meatus in horses with unilateral nasal discharge shows inspissated pus and/or fragments of conchal bone in about 20% of chronic sinusitis cases and their presence was believed to be caused by fistulation of the ventral conchal sinus. More recently, it has been shown that such inspissated pus and conchal bone at this site can also be due to purulent infection of the ventral and dorsal conchal bullae. Most cases of infected nasal bullae occur concurrently with ipsilateral sinusitis, possibly secondary to the latter disorder in most cases, but a very enlarged infected nasal conchal bulla could also obstruct normal sino-nasal drainage.

Infection of the conchal bulla is most readily diagnosed by computed tomography, but once this disorder is recognised, it can usually be diagnosed by endoscopy of the middle nasal meatus. Many cases can be treated by trans-endoscopic high pressure lavage of all debris from the middle nasal meatus and also of the lumen of the infected bullae through existing fistulae. If no fistulation of the infected bulla is obvious, they can be surgically drained using a long curved knife per nasum or by transendoscopic laser. The prognosis is very good with such treatment.

Reference

The maxillary cheek tooth infundibular caries is the most common type of dental caries identified in equidae. Clinical consequences of this progressive destruction of cementum, enamel, and dentine include the development of tooth fracture or apical infection. Because some degree of infundibular caries is commonly found on oral examination, it is difficult to differentiate between lesions that may become clinically significant and those that remain asymptomatic. Even infundibulae that appear grossly normal occlusally may contain an area of localized caries, cemental defects, or cemental hypoplasia deep to the surface. Preventative treatment procedures are likely to be more effective if the morphology of deeper and more complex infundibular defects is known before treatment.

54 maxillary cheek teeth that contained 108 infundibulae, 68 of which had caries evident on the occlusal surface, were extracted post-mortem and imaged by computed tomography to determine crown and infundibular length, along with presence and morphology of infundibular cemental abnormalities.

57/68 (84%) of infundibulae with occlusal caries had deeper infundibular defects present, however there was no statistically significant association between the presence of deeper infundibular defects and age, grade of caries, or presence of visible infundibular defects. The findings of this study confirm the poor relationship between occlusal caries and deeper infundibular cemental defects.

Data from micro-computed tomographic images and histological information is currently being assessed to ascertain the presence of vasculature within cementum at the apical aspect of the infundibulae that is known to regress with age. These preliminary results will also be presented.
Evidence of bacteremia in antibiotically untreated horses before, during and after tooth extraction

Astrid Bienert-Zeit¹, Isabelle Kern¹, Jutta Verspohl², Judith Rohde² & Claus Peter Bartmann¹

Extraction of incisors, canines and cheek teeth is a commonly performed surgical procedure in horses with the indication for antibiotic prophylaxis controversially discussed.

In humans and dogs, the occurrence of transient bacteremia during and after tooth extraction has been demonstrated and its connection with infectious endocarditis and other severe systemic sequelae is a well-established fact. Few reports of systemic infection following tooth extraction exist in horses.

In this study, blood specimens were perioperatively collected from 20 horses with extraction of cheek teeth (n=10) and incisors or canines (n=10). None of the patients had received antimicrobial therapy prior to surgery. Sampling was achieved via an aseptically placed intravenous catheter and the blood examined microbiologically using standard blood culture and sub culturing techniques. Bacteria isolated from the blood were compared to those isolated from swab samples of the extracted teeth.

Transient bacteremia during the procedure was observed in all patients with cheek tooth extraction and 8 of 10 with incisor or canine extraction. Alpha-hemolytic Streptococci, Actinomyces, Fusobacterium and Prevotella spp. were the most commonly isolated organisms. Most horses showed a mixed blood culture of aerobic and anaerobic bacteria. In two patients with cheek tooth extraction bacteremia outlasted the surgery. Bacterial genera isolated from blood culture resembled those found in the swabs. However, isolates were not classified to species-level.

In the light of these results it seems likely that transient bacteremia arising from microorganisms colonizing the oral cavity occurs in almost all equine patients undergoing tooth extraction with a potential risk of septicemia and pyemia.
The extraction of equine cheek teeth (CT) is a frequent procedure in veterinary practice. After fracture of the dental crown the classical transoral approach often fails.

The aim of this study was to describe alternative methods of tooth removal that were used after oral extraction of cheek teeth had failed or was deemed impossible. A total of 23 CT were removed in 21 horses.

For tooth removal minimal invasive buccotomy was performed in 20 cases, solitary repulsion in 1 case, a combination of repulsion and classical lateral buccotomy in 1 case and a combination of repulsion and minimal invasive buccotomy in 1 case. The removal was successful in all cases. Intra- and postoperative complications occurred in 15/23 cases. Singular complications happened in 8/15 and two or more complications in 7/15 cases. Complications were divided into intraoperative, short- and long-term as well as surgery related and not surgery related complications. The most common reason to use an alternative procedure to oral extraction was a complete fracture of the clinical crown. In one case traumatic crown impingement made oral extraction impossible.

This case series shows various alternatives of cheek tooth removal. With appropriate treatment and a combination of different surgical techniques the success rate was good even in cases considered to be difficult.
Replantation of extracorporal treated cheek teeth in the horse

Manfred Stoll

Introduction

Endodontic treatment of equine cheek teeth is still a big challenge. Root canal treatment from the occlusal surface is an advanced approach with good clinical results (Lundstrom BEVA 2012) but is not widely used because of its difficulties in endodontic diagnostic and instrumentation.

Another approach is retrograde endodontic treatment after bone removal and apicoectomy. This technique is described by different authors. The problems of this approach are the difficulties in keeping the area dry for treating the endodontic system and the difficult instrumentation.

Extra corporal retrograde endodontic therapy in freshly extracted cheek teeth is easier to perform compared to the previous listed techniques but the periodontal ligament becomes ruptured because of the required dental extraction. Success of this procedure depends very much on the periodontal regeneration after replantation of the treated tooth. First results show that periodontal regeneration is possible and can lead to functional replanted teeth with regular eruption. In human dentistry this is a very old technique with a high success rate (78%-96%).

Materials and methods

Cases were presented in the author’s clinic for oral extraction because of clinical signs of pulpitis like intraoral fistula and periapical abscesses.

If the affected tooth was extracted orally without fracturing the tooth or obvious damage of the alveolus and the crown including the reserve crown of the tooth was longer than 40 mm the case was selected for extra corporal retrograde endodontic therapy.

Procedure

- After extraction the teeth were rinsed with sterile lactated Ringer solution and wrapped with sterile gauze soaked with a sterile penicillin solution (100ml lactated Ringer + 100mg Benzyl penicillin) so the periodontal ligament was protected and kept wet.
- Granuloma and fistula tracts were removed from the alveolus. The alveolus was
checked for bone or tooth fragments.

- Now the apical parts of the teeth with roots were dissected with a diamond disc under water cooling with sterile saline solution to get a good access into the pulp chamber / pulp canals and the bottom of the infundibula.

- Pulps or necrotic material in the pulp canals was removed and pulp canals were cleaned with hedstrom files. If the pulp canals were too narrow they were enlarged with a 3mm drill under water cooling with sterile water. In cases of a patent infundibulum the bottom of the infundibulum was removed and the cement or compacted food material in the apical part of the infundibulum was removed to a depth of 10mm.

- Pulp canals and if opened the infundibulae were filled and flushed with warm sodium hypochloride (3%) to remove organic material and to sterilize the cavities. For flushing the occlusal surface was directed upside so the fluid didn’t contaminate the periodontal ligament.

- The cavities were finally flushed with sterile saline solution to remove the sodium hypochloride and were dried with compressed air.

- The deep and narrow pulp canals close to the occlusal surface were filled with a dual curing, self-etching and self-adhesive wet bond resin cement (Embrace Wet-Bond Resin Cement™).

- After light curing the surface of the resin cement the remained walls of the cavities (including the enamel wall of a maybe involved infundibulae) were prepared with a self-etch adhesive
(Adper Prompt™ or Scotch Bond™) that was light cured.

- All cavities were filled now with a self-curing composite material (LUXa Core™).
- After 4 minutes setting time the tooth was repositioned in the flushed and cleaned alveolus.
- The clinical crown was fixed to the adjacent teeth with self-adhesive cement (Embrace™) or Composite (LUXa Core™).
- Horses were fed 2 weeks with slushy feed and grass.
- Horses kept on antibiotic treatment for 10 days.

**Results**

Ten horses were treated according to the above described technique between 2010 and 2013. Rechecks were performed in a 2 week interval with an oral exam and radiographs. If the periodontal attachment was good after 4 weeks the interval was increased to a 6 month interval. 8 of the 10 horses showed full periodontal attachment at gingival line after 4 weeks. 1 horse showed increased mobility after 2 weeks and 1 horse didn’t achieve full periodontal attachment at the buccal aspect during the follow up time of 2 years with calculus formation and periodontal inflammation after 2 years.

None of the horses showed clinical relevant complications after the procedure. The 2 failed teeth were easily extracted because they were loose already.

**Discussion**

For the described case selection the extra corporal endodontic therapy with replantation seems to achieve good results in the documented period. In one case it was not possible to fix the 207 to the adjacent 208 because he was not fully erupted at this time. The 207 had too much mobility after replantation and was extracted after 2 weeks. Now we select only cases with solid adjacent teeth. This is a reason we never have chosen a 06 or 11 position for this procedure.

The second tooth that failed was a 107 with a length of 40mm crown including reserve crown after apicoectomy. Because of the small numbers it is not easy to draw conclusions from these cases but longer crowns with more periodontal ligament and more stability in the alveolus seem to have a better chance of success.

**References**


Embrace WetBond Resin Cement™: Pulpdent Corporation, Watertown, MA 02471-0780 USA
Adper Prompt™ and Scotch Bond™: 3M ESPE, USA
Luxa Core™: DMG, Hamburg, Germany
Equine peripheral caries: Plans for its investigation

Padraic Dixon & Dewi Berkent

Equine infundibular caries of the maxillary cheek teeth is a reasonably well documented dental disorder. In contrast, peripheral dental caries is a relatively recently recognised, but very significant equine dental disease that appears to have greatly increased in prevalence in the UK (Erridge et al 2012) and other countries in Europe (Gere and Dixon 2011) and North America over the past two decades. It is unclear if some of the apparent increase in prevalence of equine peripheral caries is in fact due to its increased recognition. The more serious consequences of peripheral caries include increased dental wear, periodontal disease, diastema formation, tooth fracture and apical infection. Some hypotheses on its aetiology, linked the increased recognition of this disorder, with the feeding of haylage (silage). However, recent studies have shown a relatively high prevalence of this disorder in donkeys that never had access to haylage.

To further study this disorder, a comprehensive epidemiological study will be performed to accurately determine the prevalence and severity of peripheral and infundibular caries in selected general equine populations in the UK to help confirm the extent of the problem and promote awareness amongst veterinary surgeons and horse owners concerning this disorder. If risk factors (such as high levels of concentrate feeding) can be identified, then practical advice to reduce the prevalence of the disease can rapidly be provided to veterinarians and owners.

Some preliminary histology of this disorder has been performed- that needs to be expanded on. Undoubtedly, bacteria play a significant role in the aetiology of this disorder. However, due to the difficulty in conventionally culturing and identifying any bacteria associated with dental disease, there is a major deficit in our knowledge of equine dental and oral bacteriology, both in health and disease. Modern molecular bacteriology techniques can allow identification of the bacteria associated with infundibular and peripheral caries, undoubtedly identifying many new previously uncultivable bacteria and possibly confirming the preliminary findings that streptococcus (Streptococcus devriesiei Lunstrom et al 2007; Acta Veterinaria Scandinavica, 49:10) is a pathogen in infundibular caries. Anecdotal reports that chlorhexidine mouthwashes can control peripheral caries may be supported by the bacteriology findings, and that being the case, we can coordinate a controlled study by the above practitioners on the value of long-term chlorhexidine oral therapy.
References


The microbiome associated with equine periodontal disease and oral health

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Objectives: Equine periodontal disease (PD) is a painful and common condition. The aetiology remains relatively poorly understood despite recent increased awareness amongst the profession. Bacteria have been found to be causative agents of the disease in other species, however current understanding of their role in equine periodontitis is limited, meriting further study. The aim of this study was to use high-throughput sequencing to identify the microbiome associated with equine periodontitis and oral health.

Method: Subgingival plaque samples from 24 horses with PD and gingival swabs from 24 orally healthy horses were collected. DNA was extracted from samples, the V4 region of 16S rRNA amplified by PCR and products sequenced using Illumina MiSeq. Data analysis was conducted using QIIME and operational taxonomic units (OTUs) assigned with PAST v3.02.

Results: 1570 OTUs were identified across all samples with 1175 OTUs found in health and 1107 OTUs in PD. In oral health, 463 unique OTUs were identified, comprising Proteobacteria (35%), Bacteroidetes (15%), Actinobacteria (12%) and Firmicutes (9%). In the PD group, 395 unique OTUs were identified comprising Firmicutes (42%), Proteobacteria (18%), Bacteroidetes (13%) and Actinobacteria (12%). Spirochaetes unique to each group increased from 0% in health to 6% in PD. Principal component analysis confirmed clear differences in bacterial distribution between healthy and PD samples.

Conclusion: The bacterial flora associated with equine PD is distinct from that associated with oral health. Furthermore, although some similarities exist, the bacteria associated with equine PD differ from those normally associated with this disease in humans.
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Interactive sessions
A review will be given of the available craniomaxillofacial plating systems. This includes the locking and non-locking systems, the various sizes (2.0 mm, 2.4 mm, 3.0 mm), and the required instrumentation. The indications, including mandibular reconstruction, non-union fracture repair and multiple craniomaxillofacial fractures, and selection of the appropriate system for each, will be discussed.
Decision making in oral trauma surgery

Jens Ruhnau

Text not available
Vital pulp therapy in dogs: 190 cases (2001-2011)

Niina Luotonen, Helena Kuntsi-Vaattovara, Eva Sarkiala-Kessel, Jouni J. T. Junnila, Outi Laitinen-Vapaavuori & Frank J.M. Verstraete

Objective—To evaluate factors associated with the outcome of vital pulp therapy (VPT) in dogs.

Design—Retrospective study.

Sample—190 teeth in 138 dogs.

Procedures—Medical records were reviewed; radiographs obtained before, immediately after, and during the last available follow-up examination for VPT were evaluated. Treatment was categorized as successful (with radiographic evidence of continued secondary dentin production, continued root formation in immature teeth, and absence of clinical and radiographic signs of apical periodontitis and internal or external inflammatory root resorption), having no evidence of failure (with signs for success fulfilled except the width of the apical periodontal ligament space, which could be wider than but no more than double the width of the periodontal ligament space in other areas), or failed (with radiographic evidence of pulp necrosis, apical periodontitis, or inflammatory root resorption). Associations between diagnostic or treatment-related variables and outcome were assessed with multinomial logistic regression.

Results—Overall, treatment was classified as successful for 162 of 190 (85%) teeth, including 23 (12%) teeth with no evidence of failure, and as having failed for 28 (15%) teeth. The overall success rate was 137 of 149 (92%) for teeth treated with mineral trioxide aggregate alone and 21 of 36 (58%) for teeth treated with Ca(OH)2 alone. Use of Ca(OH)2 and deep penetration of dressing material into the vital pulp were each significantly associated with increased odds of treatment failure.

Conclusions and clinical relevance—Results indicated that VPT with mineral trioxide aggregate was an effective option for use in crown reduction to treat malocclusion and for treatment of recent crown fractures in immature or mature permanent teeth. (J Am Vet Med Assoc 2014;244:449-459)
Structure function relationship: Understanding the TMJ and its disorders

Boaz Arzi

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The TMJ is a synovial joint where the head of the mandible on the condylar process articulates with the mandibular fossa of the squamous part of the temporal bone. Unlike other synovial joints that are covered by hyaline cartilage, the TMJ is covered by a unique fibrocartilagenous layer. Furthermore, an articular fibrocartilaginous disc separates the mandibular fossa and the articular surface of the head of the mandible into dorsal and ventral compartments. Essentially, the disk fills the void between the condylar process and the mandibular fossa, promoting congruity of the joint. A lateral ligament strengthens the lateral aspect of the joint capsule. The mandible is the major moving bone of the TMJ in comparison to the mandibular fossa of the squamous temporal bone that remains stationary with respect to the cranium. The TMJ structure – function relationship have similarities but also several differences across the mammalian species. For example, dogs are able to open and close the mouth as a result of the TMJ hinge movement and a slight laterotrusion movement is possible. In comparison, the cat TMJ has a closer congruity and the structure of the feline mandibular symphysis allows only a hinge movement and less independent movements of the mandible. These functionality restrictions should be considered during diagnosis and treatment. Furthermore, marine mammals such as sea lions do not chew their food. Hence, their TMJ structures exhibit few differences from dogs and cats. Other sea mammals, such as dolphins, have dramatically different TMJ adaptations.

Temporomandibular joint disorders mostly include arthritis, fractures due to trauma, dysplasia and ankylosis and rarely neoplasia. When present, TMJ disorders are usually debilitating necessitating medical or surgical treatments. TMJ arthritis can be crippling, leading to a variety of morphological and functional abnormalities. In veterinary medicine computed tomography (CT) is a major imaging tool to evaluate the TMJ as it valuable not only for evaluation of osseous pathosis but also for spatial position of the TMJ bones. Moreover, three-dimensional CT reconstructions images may improve the understanding of the lesions in selected cases. In addition, CT has been found superior to conventional skull radiographs for identification of anatomic structures and pathologies at the maxillofacial regions in dogs and cats.

Keeping in mind the plethora of TMJ disorders that may be present, the clinician needs to be aware of other possibilities, or differential diagnosis, that may be present, mimicking TMJ disorders. For example, pain on opening the mouth may occur due to retrobulbar disease (i.e., abscess or neoplasm) or ear disease. Trouble in opening the mouth may occur
due to masticatory muscle myositis. Therefore, a thorough understanding of the TMJ, its anatomy, histology and structure-function properties is fundamental for comprehensive clinical and imaging approach that require in order to formulate appropriate treatment.
Routine oral extraction of equine cheek teeth might be complicated by several factors, i.e. a fractured or malformed reserve crown or retained dental fragments within the socket. Fractured/malformed teeth or dental fragments are often not conducive for forceps extraction using an oral approach. For those selected cases, it has been suggested to create a trans-buccal approach and perform a so-called screw extraction.

The placement of the transbuccal approach is dependent on the position of the diseased tooth. It might be needed to penetrate the horse’s cheek rostral to the masseter muscle or directly through the masseter muscle. In order to avoid the risk of damaging relevant anatomical structures, such as blood vessels, nerves and salivary ducts a good anatomical orientation is mandatory. Therefore, special attention should be paid to the facial nerve and its individual branching pattern, the course and branching of the facial artery and the facial vein, the course of the parotid duct, large venous sinuses underneath the masseter muscle, position of the dorsal and ventral buccal glands, position and fiber orientation of the buccinator muscle as well as thickness and fasciae of the masseter muscle.

A transbuccal approach combined with a screw extraction technique requires good sedation and additional regional nerve blocks are recommended. The sensible innervation of the equine cheek is provided by two major nerves. The facial nerve receives sensible nerve fibers from the mandibular nerve and is therefore responsible for the sensible skin innervation in those regions where the transbuccal approach is performed. The entire inner aspect of the cheek (also those regions facing the maxillary cheek teeth) is innervated by a branch of the mandibular nerve, i.e. the buccal nerve. The teeth and their periodontal environment are in-nervated by branches of the infraorbital nerve (maxillary teeth) or by branches of the inferior alveolar nerve (mandibular teeth). Both nerves (infraorbital- and inferior alveolar nerve) travel within a bony canal and can be accessed at the rostral opening of the canal (i.e the infraorbital foramen and the mental foramen, respectively) or at the caudal opening of the canal (maxillary foramen and mandibular foramen, respectively). Although the infraorbital foramen and the mental foramen are overlaid by muscles, their positions are relatively easy to determine allowing direct access to perform a nerve block. The mandibular foramen and especially the maxillary foramen are placed in regions unaccessible for direct palpation. Related nerve blocks require inserting a needle deep into the pterygoid fossa (“mandibular foramen block”) or into the pterygopalatine fossa (“maxillary foramen block”). Nevertheless these procedures appear to be effective and safe, provided some relevant anatomical structures are avoided, i.e. the periorbita, the deep facial vein and the maxillary artery.
Minimally invasive transbuccal tooth extraction in the horse

Manfred Stoll

Text not available
Staging of the oral tumor patient

Alexander M. Reiter

Introduction

Oral tumors are common in cats and dogs. They may be of dental (odontogenic) or non-dental origin. In dogs, peripheral odontogenic fibroma, acanthomatous ameloblastoma, malignant melanoma, squamous cell carcinoma and fibrosarcoma are most commonly diagnosed in the mouth. In cats, the predominant oral tumors are squamous cell carcinoma and fibrosarcoma.

Benign lesions

Papillomas are viral-induced, cauliflower-like whitish lesions at mucous membranes and mucocutaneous junctions of the mouth. They occur in dogs less than one year of age and often resolve spontaneously in 1-3 months (unless the patient is immunocompromised).

Peripheral odontogenic fibromas are mixed odontogenic tumors and are often located in the gingiva near incisor, canine or premolar teeth. The ossifying type (previously called ossifying epulis) is distinguished from the fibromatous type (previously called fibromatous epulis) by containing varying amounts of bone or dental hard tissue within the tumor’s soft tissue. These tumors are excised together with extraction of the involved tooth and thorough curettage of its alveolus.

Ameloblastomas are epithelial odontogenic tumors. The canine acanthomatous ameloblastoma (previously called acanthomatous epulis) is a locally invasive tumor causing bone lysis around tooth roots and cystic changes. However, it does not metastasize and is therefore considered to be benign. It often has a rough cauliflower-like surface and may sometimes be similar in appearance to a squamous cell carcinoma. It occurs most commonly in the incisor and canine tooth area of the lower or upper jaw, and less commonly in the carnassial tooth area of the lower or upper jaw. Treatment is mandibulectomy and maxillectomy.

Odontomas are not true neoplasms but a conglomerate of disorganized, normal tissue cells. Enamel, dentin, cementum, and small tooth-like structures may compose the mass. Lesions with characteristics resembling normal teeth are considered compound odontomas, whereas complex odontomas have a more disorganized arrangement.
Other benign oral tumors that are less common include the inductive fibroameloblastoma (cats only), amyloid-producing odontogenic tumor, osteoma, and lipoma.

**Malignant lesions**

Malignant melanoma usually occurs in older dogs with oral pigmentation, but it is very rare in cats. The tumor is pigmented or nonpigmented (amelanotic), often grows rapidly and invades bone early. The tumor surface usually is ulcerated and foul-smelling because of necrosis caused by the lesion outgrowing its blood supply. Typical locations are the gingiva, palate, dorsal surface of the tongue, and mucosal surface and mucocutaneous junctions of the lips and cheeks. Regional and distant metastasis is common at the time of diagnosis.

Nontonsillar squamous cell carcinoma typically is a disease of older cats and dogs, but papillary squamous cell carcinoma has been described in adolescent and young adult dogs. The tumors most often are found on the gingiva as proliferative and ulcerated lesions and less often on the mucosa of the lips, cheeks, tongue and sublingual area. Bone invasion is common for gingival lesions. If occurring on the upper jaw in cats, the tumor may be less protuberant, while bone invasion is more severe. Metastasis to regional lymph nodes is common, while distant metastasis may occur late in the disease process. Tonsillar squamous cell carcinoma in dogs is highly metastatic.

Fibrosarcomas tend to occur in young adult to mid-aged large breed dogs and older smaller dogs. They affect the gingiva, lip/cheek mucosa, or the hard and soft palate and often appear as protuberant, ulcerated lesions. They may occasionally arise from the lateral surface of the incisive bone and maxilla, presenting a slowly enlarging firm mass at the muzzle. Fibrosarcomas are highly invasive. Regional and distant metastasis is less common compared to malignant melanoma and squamous cell carcinoma. Low-grade fibrosarcomas appear benign clinically but are malignant biologically.

Peripheral nerve sheath tumors are sometimes misdiagnosed as fibrosarcoma. They tend to grow along major nerves of the face, upper and low jaw (i.e., infraorbital nerve or inferior alveolar nerve).

Osteosarcoma affects the mandible and, less often, the maxilla, often manifesting as an ulcerative or necrotic oral mass with extensive radiographic evidence of bone invasion. Regional and distant metastasis seems to be less common than for limb osteosarcoma. Multilobular tumor of bone is a variant of osteosarcoma, affecting the maxilla, palate, ramus of the mandible, zygomatic arch, and calvarium.

Other less common, malignant lesions include hemangiopericytoma, lymphosarcoma, plasma cell tumor, mast cell tumor, and undifferentiated tumors.

**Thoracic radiographs and oral biopsy**

Three-view thoracic radiography should be performed prior to placing an oral tumor patient under anesthesia, particularly when a malignant oral lesion is suspected.

Proliferative masses, bone swellings and those that cause bone lysis, mucosal lesions suspicious of neoplasia or autoimmune disease, and unilateral oral inflammation/ulceration should be sampled for examination. A biopsy is preferably obtained from an area that can be included in the definitive resection. Areas of necrotic tissue may be present in rapidly growing tumors, and viable tissue should be included in the biopsy sample. A mucosal flap could be raised to access deeper tissue for tumors that are covered by a layer of variably-thick normal tissue. If cytological or histological results do not match the clinical findings, a second, deeper, and larger specimen is obtained.
The TNM (tumor, node, metastasis) system aids in describing the clinical extent (staging) of neoplastic disease through evaluation of the primary tumor, regional lymph nodes, and distant sites of possible metastasis. Parotid, mandibular, and medial and lateral retropharyngeal lymph nodes should preferably be evaluated histologically. A negative lymph node biopsy does not preclude the possibility of regional metastasis, which may occur along perineural or vascular routes, or metastasis to other less accessible lymph nodes.

Cytological sampling can be performed in the awake or sedated patient. Fine-needle techniques are useful for lesions that exfoliate well and are often performed with a 22-gauge needle by means of a needle biopsy (‘woodpecker method’) or needle aspiration. Cytological examination of lymph node needle biopsies and aspirates may be adequate for diagnosing metastatic melanoma and squamous cell carcinoma but is less satisfactory for other oral tumors. Impression smears and scrapings obtained from the surface of an epithelialized or ulcerated tumor have no diagnostic value. Impression smears and scrapings may be of much greater value if obtained from the cut surface of a tumor.

Histological sampling requires general anesthesia and microscopic examination of a formalin-fixed specimen. This is more accurate than cytological sampling. Rongeurs are great for bone samples and scalpel blades for incisional and excisional soft tissue sampling. Tissue damaging instrumentation must not be used during the sampling procedure so that a diagnosis is not obscured. Multiple samples should be obtained. Hemostasis is achieved by digital pressure, and biopsy sites of more deeply-invading tumors are sutured. For adequate fixation, the specimen is placed in 10% buffered formalin at one part tissue to 10 parts fixative.
Decision making in oral tumor surgery

Alexander M. Reiter

Introduction

Preoperative workup includes routine blood tests, blood type determination and cross-matching, coagulation profiles, buccal mucosa bleeding time, regional lymph node aspirates, and diagnostic imaging (thoracic radiographs, abdominal ultrasound, head computed tomography). The client must be informed about intra- and postoperative complications, follow-up care, long-term function and quality of life, and prognosis. A biopsy should always be taken in a location that can be incorporated in the definitive resection.

Treatment

Conservative resection should be restricted to gingival hyperplasia and viral papillomas. Peripheral odontogenic fibromas are removed together with the tooth (which is extracted) and its periodontium (which is curedtted) from which they arise.

Invasive tumors require radical resective surgery (mandibulectomy, maxillectomy, glossectomy, lip and cheek resection) to provide a cure. Combined therapy (surgery plus radiotherapy and/or chemotherapy) may be indicated, particularly for tumors with local or distant metastasis. The treatment of choice for most oral and maxillofacial tumors is wide surgical excision. Large portions of upper and lower jaws and associated soft tissues can be removed without compromise of quality of life. The practical limits for maxillectomy range from partial resection of the rostral upper jaw on one or both sides (rostral maxillectomy), a central or caudal portion of the maxilla (central or caudal maxillectomy), the entire dental arch on one side including the palate to the midline (total maxillectomy) to the entire palate and both sides of the dental arch. For more caudally located lesions that extend onto the side of the face, the bones forming the ventral and lateral limits of the orbit can be resected (partial orbitectomy). In cats the relatively small size of the skull and the short, tighter upper lip compared with that of dogs make radical maxillectomy far more challenging.

The practical limits for resection of the lower jaw range from partial resection of the mandible on one or both sides (unilateral or bilateral rostral mandibulectomy and partial mandibular body resection), one entire mandible (total mandibulectomy) to one entire mandible and a portion of the mandible on the other side. For caudally located lesions the
mandibular ramus or a portion of it can be resected by means of a dorsolateral approach through the zygomatic arch and the masseter and temporal muscles. Bilateral rostral mandibulectomy to the level of the first premolars provides good function and esthetics. Bilateral resection caudal to this level results in progressively greater problems with tongue retention, eating and grooming. Resection of the symphysis causes the two remaining mandibular sections to ‘float,’ which is functionally and esthetically acceptable. Resection should include at least 1-2 centimeters of apparently healthy tissue surrounding the tumor.

The use of electrocoagulation along the incised mucosal edges that will be sutured is to be avoided. Bone is cut with power instruments (rotating burs; sagittal and oscillating saws) or an osteotome and mallet. It is often safer to ‘break out’ the piece to be resected than to bur or saw through any remaining bony attachments. The wound is closed with a labial or buccal flap that is undermined until it can cover the defect without tension. In the case of maxillectomies, a two-layer closure is preferred, with the first layer apposing connective tissues of the flap and palate, to relieve tension on the epithelial edges.

Lingual tumors are resected with good results if the resection can be confined to the free rostral or the dorsocaudal portions of the tongue. Clamping the tongue caudal to the excision site with non-crushing forceps greatly aids in control of bleeding.

Surgical principles for resection of tumors of the lip and cheek include maintenance of a functional lip commissure so that the mouth can open adequately, separate closure of mucosal and skin incisions, avoidance of parotid and zygomatic salivary gland ducts or ligation of ducts when avoidance is not possible, and cosmetic closure of resulting facial defects by advancing or rotating tissue from the lower lip and side of the face, head or neck.

**Postoperative care**

Pain control is achieved with a combination of intraoperatively given longer-acting local anesthetics, centrally acting opioids, and NSAIDs. Patients undergoing radical resective surgery invariably benefit from placement of a transdermal fentanyl patch plus injectable opioid supplementation until the patch achieves adequate blood levels.

Chlorhexidine digluconate solution or gel (0.1-0.2%) is administered into the mouth for 2 weeks. Antibiotic treatment is not required after oral and maxillofacial surgeries in the otherwise healthy patient.

Water is offered once the animal has recovered from anesthesia. Soft food is offered 12 to 24 hours after surgery and maintained for about 2 weeks. Dogs usually eat the same or following day; cats may benefit from placement of an esophagostomy tube to ensure proper nutrition and medication during the immediate postoperative period.

Elizabethan collars, tape and nylon muzzles, or other restraining devices may be used in some animals to prevent disruption of the surgical sites.

Reexaminations are scheduled at 2 weeks (removal of skin sutures) and at 2, 6, 12, 18, and 24 months postoperatively. Collaboration with an oncologist is helpful after histopathological results return to discuss the need for further treatment (surgery, radiation therapy and/or chemotherapy).

Palpation of nonresected lymph nodes (with cytological or histopathological examination of enlarged nodes) and thoracic radiographs should be performed to monitor for regional and distant metastasis.
The goal of evidence-based medicine (EBM) is to use evidence gained from research for clinical decision making. There is a wide range of evidence quality. Double-blind, placebo-controlled clinical trials certainly provide more evidence than empirical knowledge obtained from case reports.

Sometimes, what we think is right may actually be wrong. Sometimes, what we think is wrong may actually be right. It happens all too often that we apply common treatment strategies without questioning the reasons behind their use. Evidence-based veterinary dentistry and oral surgery can only exist if we continue to evaluate our clinical work and have it backed up by science. Furthermore, we need to be open to change when there is evidence that such change is justified.

The following topics are up for discussion:

- What’s your opinion about groomers offering anesthesia-free dental cleaning?
- What’s your veterinary medical association’s stance towards non-veterinarians extracting teeth?
- What would you do if a client asks you to ‘disarm’ an aggressive pet by means of tooth extraction?
- When do you use pre-, intra- and postoperative antibiotics in your dental and oral surgical patients?
- Should we perform orthodontic therapy in show pets?
- Do tooth saving or tooth replacing procedures really improve a pet’s quality of life?
- Do we serve the pet or the owner when performing extreme life-extending procedures?
Treatment options for mandibular canines impinging the hard palate

Jens Ruhnau

Text not available
Posters
Periodontal diseases are the number one health problem in dogs and cats. The objective of this survey was to evaluate the status and awareness of the owners about the disease in Iran. Serial dental exam was performed on 56 cats and 69 dogs were referred to the Teaching Hospital disregard of the diseases they were admitted. Periodontal disease was mostly evident in cat (87%) compared to dogs (68%). Variety stages of the disease were diagnosed. However the patients were basically affected with stage 3 or 4 (75% in cats and 66% in dogs). The severity of the periodontal disease was totally influenced by the age of the patients. The incidence was more in female than male. Above 80 percent of the owners complain about the halitosis of their pets. Furcation exposure occurred in 31% of the patients, which was significantly higher in cats compared to dogs. Dental mobility due to severity of the disease was reported in 48% of the affected patients. Also only 12% of the owners had concerned about their animal periodontium. No significant difference was found in the incidence of periodontal disease in patients with owner and strayed animals, which was mostly due to lack of information about the oral hygiene. 29 of the cats and 20 of the dogs needed surgical management of the disease in addition to dental cleaning. The results of this survey highlight the necessity of the regular dental exam, educating veterinarians and pet owners.
Efficacy of a vegetable dental chew (C.E.T.® VEGGIEDENT®) for tartar control in dogs

G. Chaix & C. Navarro

Virbac Medical Department, Carros, France

Home oral hygiene is essential to prevent the formation of calculus by mineralization of dental plaque. Calculus promotes bacterial attachment and further plaque development, worsening periodontal disease. In addition to the gold standard of tooth-brushing, an edible, daily dental chew is an interesting, potential alternative option, as it does not require work by the dog owner, leading to better compliance.

The objective of this study was to determine the efficacy of a highly palatable vegetable dental chew without an anti-calculus active ingredient (C.E.T.® VEGGIEDENT®) in the mechanical prevention of dental calculus in dogs.

The study was divided into separate trials A and B, which were conducted in different independent research centres with expertise in animal dental studies. In trial A and B, respectively, 30 and 40 healthy adult beagle dogs were randomly assigned to chew or control groups. Teeth were scaled and polished for all dogs on day 0. Chew group dogs received one tested chew per day for 28 days. At day 28, calculus indices (Warrick-Gorrel method and modifications of Schiff’s method) were scored under general anaesthesia by scorers blinded to the group assignments. Statistically significant (P<0.005) overall reductions of 27.54% and 36.17% in calculus accumulation in the chew groups compared to the control group were observed in trial A and B, respectively, meeting the Veterinary Oral Health Council (VOHC®) requirements.

This study confirmed that daily use of C.E.T.® VEGGIEDENT® in beagle dogs is associated with a significant prevention in tartar formation after 28 days.
Analyzing the low incidence of cavities and the high pH of saliva the aim was to collect a small sample of saliva from 9 dogs, measure its pH and do a bacterial culture. Then, it was possible to discover if the difference between the dogs’ saliva pH and the human beings’ saliva pH is or is not a relevant factor in infection with Streptococcus sp (mainly responsible for tooth decay in humans). A small sample has been removed with a sterile swab and then sent to the microbiology laboratory where bacterial cultures were performed. Upon arriving at the laboratory the samples were passed on Blood Agar and McConkey Agar, through the method of exhaustion. When ready, the plates were placed in a greenhouse where they remained up to 72h. After growing, the plates were analyzed by observing how many colonies grew on each plate, classifying them according to size, color, shape, whether or not they were beta-hemolytic and then coagulase test, catalase and oxidase reactions were performed. Plates were made from each colony of bacteria making it possible to analyze each format, whether they were positive or negative and whether they were grouped, solitary or in pairs. Only four samples had grown on MacConkey, then classified as lactose positive and lactose negative. After this step, a kit of Enterobacteriaceae was used and the result observed after 24 hours of permanence in the greenhouse. Then the data obtained by the bacteria responsible for caries in humans was compared and investigated whether the bacteria that colonize the dog’s mouth are the same responsible for the disease. To measure the pH, measurement strips were placed under the tongue of the animal where a greater buildup of saliva was observed. The saliva pH of the the animals were in general basic, getting between 8 and 9. Bacterial cultures showed some inconclusive results and from a single sample the presence of streptococcus sp was found. We concluded that the bacterium Streptococcus sp replicates in the saliva of dogs despite the high pH.
Final year veterinary students’ attitudes towards small animal dentistry: a questionnaire-based survey

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Objectives: To investigate the attitudes of final year veterinary students towards small animal dentistry and to examine the teaching received in this subject, both at university and during extra-mural studies.

Methods: A cross-sectional study of all United Kingdom final year veterinary students in 2012 was designed and utilized by a self-administered Internet-based questionnaire.

Results: Six of seven universities participated with 188 student responses. All students felt that it was important or very important for a small animal practitioner to have a broad understanding of dentistry, and that orodental problems were common or very common in small animals. Nearly all (99.5%) students perceived small animal dentistry as an important or very important subject. Less than 40% students felt that the teaching had prepared them for entering practice. Over 50% reported that they neither felt confident in discussing orodental problems with clients, nor performing a detailed examination of the oral cavity.

Clinical significance: Dental problems are perceived by students as frequently encountered in small animal practice. The veterinary surgeon should be adequately trained to detect, diagnose and treat dental disease in small animals and many students feel that their current teaching is inadequate.

Canine keratoconjunctivitis sicca (KSC) is a common ocular disease; in cases where response to medical therapy is poor, parotid duct transposition is a surgical procedure where by the parotid duct and papilla are freed from the buccal mucosa and redirected to the ipsilateral ventral conjunctiva. Five indigenous mix breed dogs from both sexes were conducted to perform to PDT under general anesthesia. Parotid duct was cannulated 1 USP nylon string from oral papilla in labial mucosa at the level of upper carnissial tooth. A one cm incision parallel to lip border of masseter muscle was made. Parotid duct was dissected from the surrounded tissues and transposed to lateroventral part of left blepharal conjunctiva. The transected end of duct was sutured to conjunctiva. Appropriate tissue samples of parotid glands of both sides, parotid duct and lower eyelid was performed 30 days postoperatively. Histopathological study of samples revealed evidence of increased fibrous and connective tissue around transposed duct, mucosal hypertrophy of conjunctiva, but there were no pathologic changes in parotid glands of both sides. The routine drugs to treat KCS should use frequently by the owner. Thus these much administration of drugs is boring for owners and comes into stop treatment. PDT is a possible technique to treat and control KCS and prevent dryness and blindness, with not so much complication.
Periodontal disease in dogs: correlation between degree of disease, blood parameters, and systemic inflammatory response, and its response to treatment

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Introduction: Few studies on dogs have related the degree of periodontal disease (PD) with hematological and biochemical parameters or systemic inflammatory response (SIR), or analyzed the effects of treatment on them. This study aimed to determine the association between PD with such parameters and SIR (C-reactive protein -CRP- levels), as well as the effects of the treatment, in canine patients with PD, not affected by other pathologies.

Methods: Pre-surgical hemogram and blood chemistry were performed in thirty canine patients with varying degrees of PD and without other pathologies, from the Veterinary Teaching Hospital (University of Buenos Aires-Argentina). The degree of PD (TMPS® Colin Harvey) was established before the treatment. Post-surgical follow-up was carried out in 15 of the patients. Part of the serum was kept to measure pre-surgical and post-surgical CRP levels. The values obtained were correlated with the degree of PD and the response to treatment.

Results: Significant association was found between PD and various blood parameters. In patients in which follow-up took place, the treatment produced beneficial effects on these parameters. Regarding the SIR, we found an association between PD severity and CRP levels (but not statistically significant) and the effects of the treatment are seen as a significant decrease in CRP levels.

Discussion and conclusion: The results indicate that in dogs not affected by other pathologies, the degree of PD correlates with health parameters and the treatment induces beneficial changes in these health indicators and in the SIR.
The **EVDSFORUM** is an e-bulletin entirely dedicated to Veterinary Dentistry. Besides covering news about the European Veterinary Dental Society (EVDS) and its members – including congresses, programs, members’ publications, etc. – it also publishes clinical studies and reviews in oral medicine and surgery with a potential interest to the EVDS members.

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