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September 23rd-25th 2010, Nice, France

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EUROPEAN CONGRESS
OF VETERINARY
DENTISTRY

NICE 2010

Thursday 23rd - SEPTEMBER

EVDC Training Sessions: wetlabs and mock exams
see separate announcement

Welcome Reception and Congress Opening

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker</th>
<th>Type</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.00 - 9.25 am</td>
<td>Overlooked Oral Pathology Made by Veterinary Students, Interns and Residents when Compared to Veterinary Dentists</td>
<td>James M. G. Anthony Diagnostics Canada</td>
<td>Applied anatomy of the oral and nasal cavities</td>
<td>Eddy Coulon</td>
</tr>
<tr>
<td>9.25 - 9.50 am</td>
<td>Standardization of an assessment chart for occlusion and dentition</td>
<td>Philippe Roux Diagnostics Switzerland</td>
<td>Perform the Perfect Physical Examination</td>
<td>USA</td>
</tr>
<tr>
<td>9.50 - 10.15 am</td>
<td>Iatrogenic Dentistry</td>
<td>Peter P. Emily USA</td>
<td>Experimental Results Of Stream 2 - management and oral health care</td>
<td>Cedric Tutt</td>
</tr>
<tr>
<td>10.15-10.40 am</td>
<td>Experimental Results Of Cone Beam Computed Tomography in Veterinary Dentistry</td>
<td>Bert Van Thielen Diagnostics France</td>
<td>The medical necessity of dental care for pets</td>
<td>Nicolas Girard</td>
</tr>
<tr>
<td>10.40 - 11.10 am</td>
<td>Veterinary Dental Operatory Radiation Measurements from Standard Dental Procedures</td>
<td>James M. G. Anthony Diagnostics Canada</td>
<td>The Difference between a &quot;Dental Cleaning&quot; and a &quot;Professional Preventive Treatment&quot;</td>
<td>Sam L. Hole</td>
</tr>
<tr>
<td>11.35 am - 12.00 pm</td>
<td>Piezoelectric Bone Surgery In Maxillofacial And ENT Surgery: Advantages, Clinical Uses And Limits</td>
<td>Philippe Verwilghen Surgery Belgium</td>
<td>Have I managed compliance within my own structure? part 1: from waiting room until patient follow-up</td>
<td>Jean-Hugues Bozon</td>
</tr>
<tr>
<td>12.25 - 12.35 pm</td>
<td>Announcement World Veterinary Dental Congress Cape Town 2011</td>
<td>Cedric Tutt South Africa</td>
<td>Did You Brush Your Teeth?</td>
<td>Cedric Tutt</td>
</tr>
<tr>
<td>1.25 - 1.50 pm</td>
<td>A direct capping technique with using human silicon denture-base material for surgically-implanted osseointegrated defects</td>
<td>Ayako Okuda Surgery Japan</td>
<td>Orthodontic (overjet/overbite) correction foal and osteodistraction adult horse</td>
<td>Denis Verwilghen</td>
</tr>
</tbody>
</table>

Chair: Jerzy Gawor Chair: Francois Delsette Chair: Alessandro de Simoi

Chair: Jerzy Gawor Chair: Gottfried Morgenegg Chair: Jean-Yves Gauchet
<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker</th>
<th>Type</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.50 - 2.15 pm</td>
<td><strong>The Use Of Nasal Septal Button For Closure Of Oral-Nasal Fistula And Mid-Palatal Defects In Dogs And Cats</strong></td>
<td>Peter P. Emily Surgery USA</td>
<td>Management</td>
<td>USA</td>
</tr>
<tr>
<td>1.50 - 2.15 pm</td>
<td>Applying Advanced Record Techniques For Dental Disease Management In Undergraduate Bovines Of Donkeys, In Field Conditions</td>
<td>Joel B. Rodrigues Equine Dentistry Portugal</td>
<td>Management</td>
<td>Portugal</td>
</tr>
<tr>
<td>2.15 - 2.40 pm</td>
<td><strong>Evaluation Of Auricular Grafting In Traumatic Facial Deformities</strong></td>
<td>Luís F. Legendre Surgery Canada</td>
<td>Technique</td>
<td>Canada</td>
</tr>
<tr>
<td>2.15 - 2.40 pm</td>
<td>What’s More Than A Smile: Why Dental Care Matters</td>
<td>Ernie Ward Management USA</td>
<td>Management</td>
<td>USA</td>
</tr>
<tr>
<td>2.40 - 3.05 pm</td>
<td><strong>Treatment Of Mandibular Structures In Dogs With A Titanium Micro-Locking Plate Fixation System</strong></td>
<td>Loïc F. Legendre Surgery Canada</td>
<td>Management</td>
<td>Canada</td>
</tr>
<tr>
<td>2.40 - 3.05 pm</td>
<td>How I manage compliance: my own dental practice: part 2: tools and figures</td>
<td>Jean-Hugues Bozon Management France</td>
<td>Management</td>
<td>France</td>
</tr>
<tr>
<td>3.05 - 3.35 pm</td>
<td><strong>Treatment Of Mandibular Fractures In Dogs With A Titanium Mini-Locking Plate System (Compact 2.0 LOCK Mandible, Synthes): Advantages And Limits</strong></td>
<td>Florian Boutoille Surgery France</td>
<td>Management</td>
<td>France</td>
</tr>
<tr>
<td>3.05 - 3.35 pm</td>
<td>The Effect Of Floating On Fecal Fibre Length In Working Equines</td>
<td>Lieven Vlaminck Equine Dentistry Belgium</td>
<td>Management</td>
<td>Belgium</td>
</tr>
<tr>
<td>3.35 - 4.00 pm</td>
<td><strong>Evaluation Of Auricular Grafting In Traumatic Facial Deformities</strong></td>
<td>Luís F. Legendre Surgery Canada</td>
<td>Workshop Instructor</td>
<td>Canada</td>
</tr>
<tr>
<td>3.35 - 4.00 pm</td>
<td>Review Of Irrigant Solutions in Non-Surgical Endodontics</td>
<td>Stephen Jurga Endodontics USA</td>
<td>Management</td>
<td>USA</td>
</tr>
<tr>
<td>3.35 - 4.00 pm</td>
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<td>Stephen Jurga Endodontics USA</td>
<td>Management</td>
<td>USA</td>
</tr>
<tr>
<td>4.00 - 4.25 pm</td>
<td><strong>Current Concepts In Asepsis</strong></td>
<td>Stephen Jurga Endodontics USA</td>
<td>Management</td>
<td>USA</td>
</tr>
<tr>
<td>4.00 - 4.25 pm</td>
<td>Current Concepts In Asepsis</td>
<td>Stephen Jurga Endodontics USA</td>
<td>Management</td>
<td>USA</td>
</tr>
<tr>
<td>4.25 - 4.50 pm</td>
<td><strong>Current Concepts In Asepsis</strong></td>
<td>Stephen Jurga Endodontics USA</td>
<td>Management</td>
<td>USA</td>
</tr>
<tr>
<td>5.00 - 6.00 pm</td>
<td><strong>Current Concepts In Asepsis</strong></td>
<td>Stephen Jurga Endodontics USA</td>
<td>Management</td>
<td>USA</td>
</tr>
</tbody>
</table>

**Saturday 25th September**

**EVDOS World Equine Dentistry**

<table>
<thead>
<tr>
<th>Stream 1: General Dentistry</th>
<th>Stream 2: Basic Level</th>
<th>Stream 3: In-depth, Advanced Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chair: Cedric Tutt</td>
<td>Chair: Cedric Tutt</td>
<td>Chair: Cedric Tutt</td>
</tr>
<tr>
<td>Diagnostic imaging for dental disorders</td>
<td>Eddy Cauvin Equine Dentistry France</td>
<td>Eddy Cauvin Equine Dentistry France</td>
</tr>
<tr>
<td>Local anesthesia/ intubation sedation</td>
<td>Denis Verrynghen Equine Dentistry Belgium</td>
<td>Denis Verrynghen Equine Dentistry Belgium</td>
</tr>
<tr>
<td>Workshop Instructor</td>
<td>Workshop Instructor</td>
<td>Workshop Instructor</td>
</tr>
<tr>
<td>Extraction on skull</td>
<td>P Chail Switzerland</td>
<td></td>
</tr>
<tr>
<td>Local anesthesia infusion</td>
<td>Denis Verrynghen Equine Dentistry Belgium</td>
<td></td>
</tr>
<tr>
<td>Oral dental examination</td>
<td>Alessandro de Souza Cedric Tutt Italy, South Africa</td>
<td></td>
</tr>
<tr>
<td>Clinical case X Ray Reading</td>
<td>Eddy Cauvin France</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>Title</td>
<td>Location</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------------------------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>3.35 – 4.00 pm</td>
<td>Effects Of Ascophyllum Nodosum On Halitosis, Plaque And Gingivitis. A Controlled Clinical Trial In Dogs</td>
<td>Sune Wikner Periodontology Sweden</td>
</tr>
<tr>
<td></td>
<td>Periocclusal disease as a potential factor of systemic inflammatory response in the dog</td>
<td>Nastia Kozak Periodontology Greece</td>
</tr>
<tr>
<td></td>
<td>Periocclusal disease as a potential factor of systemic inflammatory response in the dog</td>
<td>Louisa Visser Restorative USA</td>
</tr>
<tr>
<td>4.00 – 4.25 pm</td>
<td>Periodontal Surgery and Guided Tissue Regeneration</td>
<td>Brook A. Nieren and Pao Thuasen Periodontology USA, The Netherlands</td>
</tr>
<tr>
<td></td>
<td>Oral Restoratives Lecture: Composites and Glass Ionomers</td>
<td>Luis Vieira Restorative USA</td>
</tr>
<tr>
<td>4.25 – 4.50 pm</td>
<td>Dental Restoratives Lecture: Composites and Glass Ionomers</td>
<td>Luis Vieira Restorative USA</td>
</tr>
<tr>
<td></td>
<td>Intravital Determination Of Animals Age Based On Tooth Radiographs With Use Of The European Otter (Lutra Lutra) As A Model Organism</td>
<td>Tomas Fichtel Czech Republic</td>
</tr>
<tr>
<td></td>
<td>Oral Restoratives Lecture: Composites and Glass Ionomers</td>
<td>Luis Vieira Restorative USA</td>
</tr>
<tr>
<td></td>
<td>A Scanning Electron Microscope Study Of Dog Root Cementum Surface Characterization</td>
<td>Paula G. Toriggia Argentina</td>
</tr>
<tr>
<td></td>
<td>Squamous cell carcinoma in European cat (Felis silvestris f. catus) – case study</td>
<td>Michal Wołoszcz Poland</td>
</tr>
<tr>
<td></td>
<td>Rubber Tire/Secondary Renal Hypersplacty/ocholelithotomy In A Cat</td>
<td>Tomas Fichtel Czech Republic</td>
</tr>
<tr>
<td></td>
<td>Intravital Determination Of Animals Age Based On Tooth Radiographs With Use Of The European Otter (Lutra Lutra) As A Model Organism</td>
<td>Tomas Fichtel Czech Republic</td>
</tr>
<tr>
<td></td>
<td>Use Of The Rapid Radiographs On Sagittal Split Osteotomy In Dog Cadavers</td>
<td>Vanessa Granadeiro Brazil</td>
</tr>
<tr>
<td></td>
<td>Commissuroplasty In A Bernese Mountain Dog</td>
<td>Horacio E. Montenegro Argentina</td>
</tr>
<tr>
<td></td>
<td>The Inflammation Disease Of Periodontal Tissues In A Ruddell Nic Western Gorilla</td>
<td>Leonor Valandro Belgium</td>
</tr>
<tr>
<td></td>
<td>Dental Pathology In Beef Cattle – An Alkohol Survey</td>
<td>指南a Matos da Silva Brasil de Prados Brazil</td>
</tr>
<tr>
<td></td>
<td>Prevalence Of Oral Diseases In Oncilla (Leopardus Tigrinus) In Captivity</td>
<td>Marco Anancis Gisso Brazil</td>
</tr>
</tbody>
</table>

**Poster:**

1. A Scanning Electron Microscope Study Of Dog Root Cementum Surface Characterization
   - Paula G. Toriggia
   - Argentina

2. Squamous cell carcinoma in European cat (Felis silvestris f. catus) – case study
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   - Poland

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   - Tomas Fichtel
   - Czech Republic

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   - Tomas Fichtel
   - Czech Republic

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   - Brazil

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   - Argentina

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   - Belgium

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   -指南a Matos da Silva Brasil de Prados
   - Brazil

9. Prevalence Of Oral Diseases In Oncilla (Leopardus Tigrinus) In Captivity
   - Marco Anancis Gisso
   - Brazil
Friday, September 24th
Overlooked Oral Pathology Made by Veterinary Students, Interns and Residents when Compared to Veterinary Dentists

James Anthony

As a means of identifying veterinary students, interns and residents weaknesses in identifying oral pathology that could be used as foci for teaching, fifty randomly routine vaccination cases were selected. Final year students would first perform a full physical examination on the animal and then an intern and or resident would also perform a full physical examination on the patient prior to vaccinating it; all abnormal findings are to be recorded in the medical record. Once finished, a boarded veterinary dentist and a veterinary dental resident would both perform and oral examination and record their findings. Medical records were collected and analyzed. The ability to identify oral pathology is an important attribute of veterinary graduates. Recognition of abnormalities is an important foundational tool for diagnosis and subsequent treatment of pathology. The finding will be discussed in this presentation and weaknesses in teaching will also be discussed and recommendations made.
Standardisation of an assessment chart for occlusion and dentition

Philippe ROUX DVM, Dipl EVDC, Private Practice, Peseux, Switzerland

Introduction

Occlusion and dentition are the main criteria used in the evaluation and classification of show dogs and in the evaluation and selection of breeding dogs. Each breed club establishes its own rules based on historical decisions, aesthetic factors, heredity, debilitating impact, etc… The master rule is normocclusion and full dentition. But there are plenty of exceptions to the rule. Moreover, breeding rules may vary from country to country within the same breed. Class III malocclusion is considered to be the standard in some breeds (boxer, bouledogue, Pekingese...). The decision to accept missing teeth or malocclusion appears to be arbitrary. These accepted malocclusions sometimes cause pain or increasing / promote periodontal disease.

Contrary to what has happened with Hip/Elbow dysplasia, Patella Luxation or eye malformation, there is no official assessment system initiated by veterinary specialists for the evaluation of occlusion/dentition in dogs. This situation allows lay people (breeders, clubs, judges,...) to arbitrarily decide on non-scientific bases what is considered acceptable or not. Of course, clubs are free to establish their own criteria regarding the cosmetic appearance of their breed and the measures to be taken to achieve that. But breeders need to know what is considered physiological normal: what criteria are used to evaluate normal occlusion; how many teeth and what types of teeth are found in the dog; what is the normal position for each tooth. Where the responsibility for establishing standards is in the hand of clubs, it is the role of veterinarians to discourage any attempt to favour a phenotype that will lead to pain or discomfort. It is also our responsibility to make recommendations to clubs who might need our help on this topic.

Actual selection factors are based on two (sometimes contradictory) aspects. The requirement to have a head (skull) shape corresponding to the breed standard and the need to have a full dentition. In dolichocephallic and mesocephallic dog breeds, those requirements are easily met. In brachycephallic dogs however, a short face and full dentition without tooth rotation and/or crowding is impossible to achieve. This tooth malocclusion is known to promote periodontal disease. Phylogenetic evolution would have required millions of years to adapt dentition to a shorter face, either with smaller sized teeth or fewer teeth (or both).

Another aspect of concern for veterinarians is jaw occlusion. Some malocclusions are well tolerated without pain or discomfort like Class III malocclusion. Other malocclusions like Class II malocclusion, can be very painful, lead to periodontal disease, palatal impingement and tooth displacement. The establishment of a breed standard with such debilitating inherited factors must be strongly discouraged.
Template

To improve this situation, we need an internationally accepted tooth and dentition assessment tool, improve education of non-specialist veterinarians and non-veterinarian interested people.

The tool I propose is a template with objective, well defined criteria to evaluate tooth number, tooth position and jaw occlusion. If this template is accepted by national clubs as the official dentition assessment report, it should be included in the animals pedigree. To add more weight and enable control of the dentition assessment, only veterinarians with specialist level qualifications should be authorised to certify animals.

Tooth number: Physiologically, a dog has 42 teeth. Every single tooth must be checked and assessed. If a dog has one missing tooth and one supernumerary tooth, he still has 42 teeth, but this is not a full dentition.

Tooth position: Every tooth must be in its correct position. The report must describe any deviation to the norm: rotation, crowding, bucco-, rostro-, palato-, disto-version, impaction, extrusion, etc.

Jaw occlusion: The occlusion is evaluated using the following 4 criteria: 1. occlusion of the incisors 2. occlusion of the triade (incisor-canine-canine) 3. occlusion of the premolars 4. occlusion of the carnassial teeth.

This assessment form is a collection of objective criteria. It is then the Breed club’s responsibility to determine what is acceptable and what is not acceptable.

Conclusions

A professional evaluation of the dentition and occlusion using a standardized template would provide breeders, clubs and judges a useful tool in the selection / judging process.
Experimental Results Of Cone Beam Computed Tomography In Veterinary Dentistry

Bert Van Thielen, Francis Siguenza, Bassam Hassan
Email: lafourbure@free.fr

Introduction

Radiographic imaging of teeth and jaws of dogs and cats plays an important role in clinical diagnosis for many dental pathological conditions. Careful clinical examination is crucial and the value of radiographic imaging cannot be overstated. However, the amount of radiographic information visible on conventional two-dimensional (2D) projection radiographs is often limited due to super-imposition of anatomical structures. Three-dimensional (3D) imaging with Multi Detector Computed Tomography (MDCT) can solve this problem. However for veterinary dental clinics, the installation, operation and maintenance costs and labour of a standard MDCT system can prove prohibitive in most cases.

A new CT technology, Cone Beam Computed Tomography (CBCT), has recently been introduced in human dentistry [2], [4], [7] and [11]. CBCT technology was quickly adapted in the human clinic since it offered decisive advantages over MDCT in terms of reduced radiation dose, costs and labour constraints.

Cone Beam Computed Tomography (CBCT) technology:

CBCT was developed in the 1990s as an evolutionary process resulting from the demand for three-dimensional (3D) information obtained by conventional MDCT scans. This development was due to the invention of the practical cone-beam algorithm [1], which is in fact a mathematical back projection of radiographic images obtained in 360° around the object of scanning [7]. This by means of a cone shaped X-ray beam that travels 360°, 270° or 180° around the patient with the motion centre placed in the area of interest and the X-ray detector on the opposite side of the circle, radiographic data are sampled and transferred to a computer (see fig 1) [2]. The first application fields were dental and angiographic imaging, but today a lot of applications are commercially available in different fields of human medicine [7]. CBCT works by using one simplified X-ray tube. The X-ray beam can be pulsed or continuous. Contradictory to MDCT, there is only one detector, which can be a Coupled Charged Device (CCD) or a Flat Panel Detector (FPD) [2], [7]. Beside the price, an FPD has a more regular rotation field, because of the lower mass of the detector, which results in a more homogenous reconstructed FOV [3]. Other advantages of an FPD are a higher detective quantum efficiency (DQE), a higher dynamic range, a higher spatial resolution, a higher linearity and the ability of more image acquisition rates [3]. Most of the dental CBCT’s are using a CCD, whereas FPD is more often reserved for angiographic applications. Several studies have shown the correct linearity of CCD technology for dental CBCT [5], [6], [8], [9] and [10]. Linearity and geometry is established as correct in CBCT-dental devices in order to perform maxillo-facial surgery or in order to insert implants [7]. But, practically it has been proven that the linearity is correct in the centre of the FOV and that the fault is becoming significant with measurements larger than 10 cm or with measurements taken in the peripheral area of the FOV [10]. CBCT devices are very application specific, which means that; using CBCT-dental-devices, no contrast in soft-tissue structures can be seen, this due to the limited mAs, the limited HounsfieldUnit scale and the application specific window [7]. These specific limitations enable the reduction of power, cooling and hardware to a minimum which influences the affordable price of the technology [7], [2].
CBCT dental devices are custom made in a way that no specific radiographer skills are needed to perform patient positioning and image acquisition. This means that only a few parameters need to be changed when positioning the patient. Some CBCTs need standing patient positioning, other scanners need sitting patient positioning and still other units need patient positioning in supine position on a scanning table [2], [7]. Positioning is an important issue when using CBCT technology due to the influence of the projection laws [7]. Artifacts that can appear are aliasing, due to under-sampling of data, beam-hardening, scattering and the truncated view artifact. A CBCT specific artifact due to the limited range of the detector is the fact that air can be shown as soft-tissue [7].

The purpose of this study was to evaluate a dental CBCT, with CCD technology, for performing panoramic and parasagittal reconstructions of the head of the dog and the cat.

**Material and Methods**

**CBCT scan:**
The heads of 6 dogs and 2 cats were amputated and frozen in the 24 hours after death and defrosted 24 hours prior scanning. A CBCT-dental-device for supine patient positioning (NewTom 3Gâ“¢) was used in order to easily perform positioning of the isolated heads and to be able to perform scans of living dogs and cats in a later study. The isolated heads were positioned with the occlusal plane perpendicular to the floor, to have a position close to that of humans. The operator had the choice between a field of view (FOV) of six, nine or twelve inches. The scan parameters including kV, mA and scan time, were automatically determined by the scan software for each patient with every chosen FOV (see table).

**Data analysis:**
Panoramic, half panoramic and parasagittal reconstructions were made using the scanner software. The panoramic and half panoramic images were reconstructed by drawing a curve following the mandibular arch for each skull using a slice thickness of 5, 10, 15 and 20 mm (see fig 2). Image quality was assessed on the visibility of anatomical structures including teeth, alveolar bone and canals.

**Results**
Unfortunately, with this CBCT technology mAs is automatically adapted so that the mAs obtained for each of these 8 skulls was very low, see table. The average mAs used for each dogsâ€™ skull was 5.2 mAs with a highest value of 12.68 (dog 4) and a lowest of 0.81 (dog 5). The average mAs used for the skull of the cat was 0.54 mAs.

Due to this fact, an increased noise level was observed in the panoramic reconstructions of cats. Concerning the dogsâ€™ heads; moderate image quality was obtained for the panoramic reconstructions and satisfactory image quality was obtained for the parasagittal reconstructions through multiple teeth (fig 3). Image quality of panoramic and half panoramic reconstructions using a reconstruction width less than 10 mm was less satisfactory.

**Discussion**
This study was performed to examine the feasibility of using CBCT technology to create panoramic and parasagittal radiographs of dogs and cats. Moderate image quality was obtained for the panoramic reconstructions of the dog (fig 4), and inferior image quality was obtained for the panoramic...
reconstructions of the cat due to increased noise level. Satisfactory image quality was obtained for the parasagittal reconstructions of the dog through multiple teeth. In comparison to CBCT â€“ images in human medicine, our results are less satisfactory. Two major causes may contribute to this variation. First, in human dentistry a slice thickness of 5 mm is required to give panoramic reconstructions with high contrast and detail. Due to the fact of anatomical variations in different breeds of dogs (prognathism), a slice thickness anywhere between 10 and 20 mm is required to make panoramic reconstructions with enough contrast. Second, due to the automatically adapted dose reduction system in this scanner, the radiation dose delivered to the object was beneath every limit to acquire a satisfying image quality.

In veterinary medicine, it has been described recently that full-mouth radiography of dogs and cats can produce additional radiographic information such as the extent or type of tooth fracture, presence or absence of a periapical lesion, presence of a periodontal endodontic lesion, empty alveolus or root fragment, embedded tooth, extent of a tumor or the presence of deciduous teeth [12], [13]. The practical implantation of such full-mouth radiographs in veterinary practice, however, is associated with extra work hours for nurses and veterinarians. The advantage of CBCT in this regard could be that with a single scan, volumetric data are sampled which can then be used to reconstructed detail dental panoramic, thin-slice multi planar reformatted (MPR) and 3D volume rendered (VR) views of the skull.

Conclusion

This study shows the potential that an adapted CBCT could have for studying dental anatomy and pathology of dogs and cats teeth and jaws panoramic and parasagittal reconstructions.

The automatically adapted mAs and the anatomical variations of different breeds (prognathism) makes that inferior and moderate image quality was obtained. For using such technology in veterinary dentistry, technological and informatical adaptations are needed to increase the current (mAs) when scanning. Further research into patient positioning for living dogs and cats is also needed in this regard.

References

Veterinary Dental Operatory Radiation Measurements from Standard Dental Procedures

James Anthony

There are numerous papers in the human literature reporting the radiation field generated from the x-raying of patients in the human dental surgery room. However, little is mentioned in the veterinary field. With the advent of increased veterinary dental care in companion animal practice, more and more dental radiographs are taken. Most veterinary dental operatories are in smaller rooms, that are not lead lined and radiation protection can be minimal. Due to the space constraints there can be considerable disruptions of work when staff is asked to leave during the taking of radiographs. This survey was conducted to: determine the radiation field veterinary dental staff working in the operatory are exposed to; to determine a worse case scenario of radiation accumulation for an unprotected person in the operatory; and the amounts of radiation exposure at different angles to the collimator (0 degrees to 180 degrees). This study was conducted using normal day to day practice methods and patient positioning using standard veterinary dental radiograph machines to simulate a normal practice scenario. A summary of the findings and calculations of doses will be described in the presentation along with recommendations for a practice situation.
RF2: A Novel Oral Health Principle

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Introduction
Bacteria can grow as either planktonic cells, i.e. free-floating, unattached, single cells or as biofilms, i.e. three dimensional communities of attached cells. Commensals of the mouth can adhere to teeth, produce an extracellular sticky polysaccharide matrix and form a biofilm known as dental plaque. Unlike the harmless planktonic commensals, this biofilm causes numerous complications such as simple tooth decay in humans and gingivitis and periodontitis or worse in pets. Although awareness of the importance of plaque control is increasing, plaque-related problems remain tough to tackle, especially since dental plaque is notoriously difficult to eradicate. Current prophylaxis and treatment of dental plaque mainly rely on the use of antimicrobials, e.g. chlorhexidine to reduce the bacterial numbers in the mouth. Although good results have been reported with antimicrobial products both in vitro and in vivo their ability to completely eradicate biofilm-related problems is questionable. Furthermore, as they do not only target the biofilm microorganisms, but also kill off harmless commensals they disturb the natural oral, and perhaps intestinal, flora and may cause more harm than good.

Set-up of the BUCFLOR project
The BUCFLOR project was set up to search for new natural actives that, unlike anti-plaque chemicals target the basis of plaque-related problems, i.e. the biofilm as a community instead of the harmless bacteria as individuals. The aim of the project was to find a natural active that prevents bacteria from forming plaque, without killing them. To this end the antibiofilm activity of a select group of natural extracts was evaluated using a custom-developed continuous flow biofilm system with modified robbins devices (MRD, Fig. 1 and Fig. 2). Using this system biofilms can be grown in vitro on different surfaces. In this particular case, hydroxyapatite disks were used as substrate as this is the material teeth are made of. The extracts were tested at a concentration where no antimicrobial effects could be detected (in a standard MIC test) to make sure only the biofilm development was targeted.

Results
Among other active extracts, a Rhubarb extract was selected as having the most interesting activity. Afterwards, using the biofilm-assay to guide the liquid-liquid fractionation and preparative HPLC purification of the crude rhubarb extract, a pure active component was obtained. Chromatography and NMR revealed that this molecule possessed a planar aromatic, specific anthraquinone structure, which allows it to slide into the bilayer of the bacterial membrane (see Fig. 3). Further elucidative experiments using fluorescence anisotropy demonstrated that the active molecule can cause a change in bacterial membrane fluidity (78% change) and anisotropy (15% change), without exerting a toxic effect on the cell itself. We hypothesized that although this change is not lethal, it prohibits the cells from either attaching or forming a flexible three dimensional structure, necessary to sustain the biofilm architecture. Biofilms are continuously exposed to shear forces and need to be sufficiently elastic to withstand these. If they are rendered more rigid, they can become brittle and get dislodged or destroyed by these same shear forces.

In vivo trial in beagle dogs
Finally a custom extraction procedure was developed to obtain an enriched rhubarb extract, which we dubbed RF2. A clinical trial in 18 beagle dogs was undertaken to determine the in vivo efficacy on preventing plaque formation of a dental wax containing RF2. Plaque was scored using the method described by Logan and Boyce. This involved staining the plaque with eosine and scoring the teeth according to the percentage of tooth surface that was colored and the intensity of the color. Teeth from the upper and lower jaw and left and right side of the mouth were scored. A mean score was calculated for the whole mouth. Daily application of 20mg of RF2 over a period of 14 days resulted in a 50% decrease in plaque formation.

References

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Piezoelectric Bone Surgery In Maxillofacial And ENT Surgery: Advantages, Clinical Uses And Limits

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Ultrasonic medical and surgical devices operate in the high-power (10–300W/cm²) low-frequency range (20–60 kHz) by creating vibratory energy for biological tissue cutting, ablation or fragmentation, and removal. This technology is used in many medical fields such as dentistry, phaco-emulsification in ophthalmology, tissue dissection in abdominal surgery, bone cutting in orthopaedic and maxillofacial surgery neurosurgery, selective fragmentation and removal of pathological (e.g. tumour) tissue, bone cement removal and lipoplasty (Table 1). [Daly B.J and al. Journal of Materials Processing Technology 200 (2008) 38-58]

Technology
Ultrasonic bone cutting instruments have been first proposed by Vang in 1955 but did not gain popularity up until the 2000 when the need for precise bone cutting has been emphasized in maxillofacial surgery with the development of cortical bone graft and sinus surgery prior to dental implant placement. (Vercellotti et al.,2001). The technology is based on inverse piezoelectric activity: electricity applied to a piezoactive ceramic generates high-frequency vibratory energy. Frequencies of 25–35 kHz (Hertz = vibrations per second) are specific for cutting mineralized tissue, reducing the risk of nerve and vessel damage. Soft tissue cutting requires frequency above 50 kHz (Labanca et al., 2008). These vibrations results in a high-frequency almost linear reciprocal motion of the metallic tip of the instrument (Figure 1 : Courtesy Satelec/Acteongroup).

Advantages
Piezoelectric bone surgery has a selective cutting efficacy. At frequency in the range of 25-35 kHz only hard tissue are affected and soft tissue are spared. The cutting instrument is made of a handle, not very different from the ultrasonic scaler handle, where specific tips a attached. The tips can be made with different shapes and sizes and might be sharp, dentate (saw type) or diamond-coated. As for any ultrasonic device, the cutting efficiency resides in the machine, the tip should be used with low pressure on the bone. With saw-type tips, it is recommended to first mark the bone with the teeth of the instrument, then to connect all the marks by drawing a line with the tip in a back and forth motion. The newest machine such as the Piezotome (Satelec, Acteon, Group, Méringac, France) have a high power (up to 60 W) which enables them to cut dense cortical bone a lot faster than first generation machines. The machine is equipped with a sterile irrigation system, which helps cleaning the operatory site, dissipating any heat due to friction (piezoelectric technology does not generate it itself) and favor hemostasis through cavitation effect. The handpiece is equipped with very high luminosity LEDs (100,000 Lux) which enable better visualization of the operatory site even in deep locations. The efficacy and safety of piezoelectric bone surgery has been challenged in neurosurgery where it has been shown that osteotomy of parietal bone of the cranial vault could be achieved without lesion of the dura matter (Kotrikova et al., 2006).

Clinical uses
We have been using piezoelectric bone surgery for two years in the following applications:
ostectomy/osteoplasty, apical surgical access, osteotomy of mandibular bone and bones of the maxilla, cortical bone graft harvesting for reconstructive procedures, zygomatic arch resection, TMJ resection, nasal/maxillary osteotomy for dorsal rhinotomy and tympanic bulla trepanation for middle ear surgery.

Compared to other bone cutting devices that we have been using in the past (manual bone chisels, rotary instrumentation and miniature oscillating saw) the biggest advantages of piezoelectric bone surgery reside in:

- the safety of the device when use in location where blood vessels and nerves are located and/or where the surgical access is limited (mandibular body, TMJ, vertical ramus of mandible, caudal maxillectomy),
- the lack of thermal damage and bone necrosis
- the different cutting tips which can adapted to different bone density and different bone locations (saw-tip tips for dense cortical bone, angled-tip for limited accesses, diamond-tips for delicate cutting or grinding),

Limits
The recent marketing of the new generation of piezoelectric handpiece for bone surgery, Piezotome (Satelec, Acteon, Group, Mérignac, France) which has an expanded power has overcome most of the limits of the machine. It has to be acknowledge however that the use of the machine requires a training period. Other bone cutting devices such as hand chisels or rotative instrumentations might be faster in specific conditions, but lack the precision and safety of piezoelectric instruments. Beside specialists, veterinarians practicing oral-maxillofacial surgery but also orthopeadics and/or neurosurgery can make the best use of this instruments. The machine also exits in a more versatile version as a dual piezoelectric handpiece /surgical rotative handpiece (Implant Center (Satelec, Acteon, Group, Mérignac, France).

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A direct capping technique with using human silicon denture-base material for surgically-untreatable palatal defects

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Acquired palatal defects are often occurred by trauma, severe periodontitis, tumor removal, severe ulcerative lesions and unknown reasons. Most cases can be repaired surgically with using oral membrane. The donor site can be extended to labial and or buccal membrane with or without extractions. However, cases with high risks of general anesthesia or aggressive surgeries, especially the extensive membranous defect after radiation therapy with or without surgically tumor removal generally are generally difficult to be corrected surgically. For those cases palatal cap is one of treatments for separating nasal cavity from oral one. Silicon, acrylic resin or metal are used for making palatal caps after the impression of the defects 1,3), but this requires anesthesia twice. Also a direct capping method with using acrylic resin or thermoplastic material for orthopedic surgery has been introduced 2), but the materials are not flexible, that animals feel uncomfortable and make eat difficult.

Using human silicon denture base is flexible and soft to give membrane less damage and stay longer in oral cavity without deformation or tearing. Also it is easy to be modified without specific technique or equipment at chair side.

Materials & Methods

case 1: female Sheltie with nasal tumor previously treated surgically followed by radiation therapy. Sheltie had been lost skin and nasal bone around the area that was radiated. It had been kept opened. Because of this the dog constantly sneezing and sometime coughing.

case 2: female miniature pinscher had extensive defect by unknown reason. The animal had high risk anesthesia with heart failure and respiratory problem. In the oral cavity all teeth were gone with thinned membrane covered on un-evened maxilla. Bleeding from membrane was observed sometimes.

case 3: female Pomeranian with SCC on the palate and nasal cavity treated by palliative radiation therapy. The animal had palatal defect caused by radiation, but tumor tissues had been growing.

Under general anesthesia defect area should be cleaned after intubation. Enough silicon material (Sofiliner tough, Tokuyama, Japan) to be able to cover defect area send out on a plastic plate from the cartilage. Material presses gently onto the defect, which allows some material flow out the floor of the nasal cavity. It takes to set for 3~4 min. Once it sets, it is removed from the palate to be plasticized.
Only the case 1 needed bandage with an E-collar to keep the cap stay on the nose.

**Results**

All cases with applied palatal cap got less symptomatic. However, the case 2 and 3 needed that caps reshaped three times each 3 to 6 month because the defects gets bigger and wider.

**Discussion**

The material introduced here is soft and flexible enough the tissues to be less damaged and more movable. Also it keeps in shape longer and tougher. Only needs the cap enough maxillary bone to be held cap. Longer capping made defects wider. This may cause tumor growing or movement of capping. However, this material works well and safer.

**References**


The Use Of Nasal Septal Button For Closure Of Oral-Nasal Fistula And Mid-Palatal Defects In Dogs And Cats

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There are often cases of oral nasal fistulae that remain after primary closure failure and mid-palatal foramina that are located either too far caudally or there is not enough adjoining tissue to effect flap closure. The use of oral nasal buttons adapted to occlude these foramina provides an excellent closure modality where surrounding tissue has either been compromised, is of poor quality, or not enough tissue remains to perfect flap closure. The subjects of this case report are, 1) a 20 year old afghan dog with (3) oral nasal fistula closure failures, and 2) a mixed breed domestic cat with a 1 cm x 10 mm palatal fissure located at the junction of the hard and soft palate, leaving insufficient palatal tissue to effect flap closure. Both cases were successful after use of nasal septal buttons for closure.

The nasal septal button device has never been used in veterinary dentistry, so references are unavailable as this report details original surgical procedures and use of materials.
Evaluation Of Auricular Cartilage Graft To Repair Oronasal Fistula Technique: A Review Of Several Cases

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Oronasal fistulae repair can be difficult to correct and several techniques have be designed to help in their repair. They range from single flap technique to double flap technique to rotational flap and more. This new technique consists of harvesting a cartilage flap from the ear pinna and transplanting it to the defect to serve as a scaffold for the connective tissues.

Materials and Technique
The dorsal surface of the ear pinna is shaved and prepared for surgical procedure. An incision is made in the middle of the ear and the tissues are dissected bluntly down to the cartilage. A pair of Gelpi retractors are useful to keep the area exposed.

The size of the fistula is measured (Figure 1) and a flap 1.5 times the size of the defect is removed from the ear. The cartilage is cut with a scalpel and then peeled away from the inner skin of the pinna. Care must be exercised to avoid perforating the skin. Once removed, the cartilage is stored on a saline soaked gauze (Figure 2). The connective tissues are closed in a continuous manner using fine absorbable sutures (Monocryl 5-0). The skin is closed in a subcuticular manner with the same suture material.

Next, the fistula edges are debrided and mobilized. The cartilage flap is then introduced between the bony edges and the soft tissues. Mattress sutures are placed in the corners of the flap to stabilize it (Figure 3). The edges of the defect are then freshened and sutured closed over the cartilage (Figure 4). One should try to completely cover the defect but healing will still take place is some of the cartilage is exposed. Monocryl 4-0 has been the suture used for the closure.

The patients were sent home on antibiotics for 7 days, analgesics for 3 days and soft food for 10 days. They were evaluated at 7 and 14 days (Figure 5).

Ten ONF repairs were performed on 7 patients. All the ONF, but one, were secondary to extraction of maxillary canine teeth. Half of the ONF were recurrent some had already been repaired 4 times. So far this technique has been successful in 100% of the cases.

Discussion
The reasons ONF repairs often fail are many: tension on the suture line, dehydration of the underside of the flap, constant motion of the flap and lack of vascularization are a few. Placing a cartilage below the connective tissues minimizes dehydration as the underside of the repair is not exposed to the nasal cavity. The cartilage also provides stability to the repair that encourages revascularization and healing. No technique is ever 100% successful but the auricular cartilage graft certainly shows promises deal with a condition that often frustrating to correct.
Treatment Of Mandibular Fractures In Dogs With A Titanium Mini-Locking Plate System (Compact 2.0 LOCK Mandible, Synthes®): Advantages And Limits

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Introduction

Various surgical techniques have been reported in the literature for the repair of mandibular fractures including plates and screws. With the development of osteosynthesis in maxillofacial surgery, different systems have been designed in order to be smaller and easier to use. Internal fixators, or locking plates, are the most recently developed. An internal fixator has a locking mechanism between the screw heads and the plate holes. The Compact 2.0 LOCK Mandible® system was designed for treatment of mandibular fractures in humans, and it has been proven to be a suitable implant for this indication in both biomechanical and clinical studies. The aim of this report is to describe the Compact 2.0 LOCK Mandible® system and to illustrate with clinical cases done in 2009 its advantages and its limits when used for repair of mandible fractures in dogs.

Material description

- Plates
The Compact 2.0 LOCK Mandible® system is made up of different plates with threaded holes. It comes in plates of four different thicknesses; 1.0 mm, 1.3 mm, 1.5 mm and 2.0 mm. The plates are available in several lengths with different numbers of holes (with a maximum of 20 holes), they can be cut at the desired length. Various shapes exist for each thickness of the plate. (There is a 2.4 mm system which has a plate thickness of 2.5 mm and can be used with 2.4 mm and 3.0 mm screws).

- Screws
Screws have a diameter of 2.0 mm. There are two main types of screws: locking screws with a threaded head which fill congruently the thread hole of the plate, and cortical screws with a "normal" (non-threaded) head. The screws can be chosen self-tapping or self-drilling and they are available in different lengths (see table 1). A drill of 1.5 mm is used before insertion of self-tapping screws. Emergency screws are available, they are self-tapping and have a diameter of 2.4 mm.

<table>
<thead>
<tr>
<th>Type</th>
<th>Lengths available (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lock</td>
<td>Self-tapping 5,6,8,10,12,14,16,18</td>
</tr>
<tr>
<td></td>
<td>Self-drilling 5,6,8</td>
</tr>
<tr>
<td>Cortical</td>
<td>Self-tapping 4,6,8,10,12,14,16,18</td>
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<tr>
<td></td>
<td>Self-drilling 4,6,8</td>
</tr>
<tr>
<td>Emergency</td>
<td>Self-tapping 6,8,10,12</td>
</tr>
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Table 1: Lengths of screws available in the Compact 2.0 LOCK Mandible® system
All plates and screws are made of titanium which gives to the system anticorrosive, antimagnetic and antitoxic properties resulting in high biocompatibility.

Principle and stability of mini-locking plates: litterature review A stability three times higher than conventional miniplates was observed when miniplates with the minilocking-system were compared in an in vitro trial. The application of this system requires no plate pressure onto the bone to maintain stability. The thread hole of the plate is congruently filled with the screw head. At one end, the screw is anchored into the plate and at the other end, into the outer cortex of the bone. By this a rigid frame was constructed in all three planes. In contrast to conventional fixation techniques, the bone is loaded more evenly under changing directions of force. The principle of the mini-locking-system is analogous to external fixation, this simplifies plate bending and decreases torsion or opening at the fracture site. The main difference is that the plate is located closer to the bone, but does not have intimate contact. The absence of pressure underneath the plate prevents interference with the vascular supply of the bone and allows periostium to grow under the plates supporting fracture healing. The locking principle prevents stripping as well as movement and loosening of screws.

In comminuted or defect fractures fixation, conventional plating systems can lead to secondary dislocation as soon as the pressure between plate and bone is no longer guaranteed. Plate fixation with locking screws can avoid this complication. Furthermore, a poor quality bone anchoring of screws can lead to screw loosening and subsequent loss of reduction. Due to the secure locking of the screw in the plate this problem can be avoided by the use Compact 2.0 LOCK Mandible® system.

Clinical interests and limits of Compact 2.0 LOCK Mandible® system: Personnal findings Based on the cases of mandibular fractures treated with this system during the last year, we can express the following comments.

First clinical advantage of Compact 2.0 LOCK Mandible System® is due to the small size of the mini-plates. It enables to limit surgical trauma and peripheral soft tissues injuries, thus reducing risks of damage to tooth roots, dental tissues and neurovascular bundles. This system can be used with fewer screws than conventional plates. Furthermore, because locking screws are under minimal tensile preload, they do not need to engage two cortices and can be monocortically inserted. Their holding power depends on the presence of healthy cortical bone. Elastic properties of titanium plates and specific cutting plier allow to bend and curve easily the mini-plates.

The use of self-tapping screws appears to be useful: it avoids a time-consuming step and the insertion of the screw is easy. Thus, the risk of losing the reduction is limited. Setting of self-drilling screws necessitates only one step to be anchored. They can be really useful and quickly inserted but their anchorage into bone requires to apply a great force which can lead to loss of the reduction. A disadvantage of self-drilling screw could reside in the fact that its tip is really sharp, it can lead to soft tissue damages after insertion and post-operative pain.

Globally, Instruments and implants are found to be easy to handle. The good locking of the screw in the plate necessitates an angulation close to 90° which can be difficult to obtain in some situations. If necessary, non-locking screws can be used with the threaded plate holes which permits greater angulation.

References


Review of irrigant solutions in non-surgical endodontics

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The role of microorganisms in the pathogenesis of pulp and periodical diseases is well documented as Kakehashi’s colleges showed that no apical periodontitis developed in germ-free rats, when their molars were left open to the oral cavity (1). One of the main goals in endodontic therapy is the elimination of microorganisms from infected root canal system. This can be a challenging task, as the root canal space has a complex, varied anatomy and irregular spaces such as depressions, culdesacs and isthmuses. Many methods have been used to reduce the numbers of root canal microorganisms, including various instrumentation techniques, irrigation regimes, and intracanal medicaments. This presentation will discuss current irrigation solutions used for chemical debridement and disinfection of the root canal system.

Shape to Clean

After appropriate access preparation, mechanical instruments are used to shape the canal. Initially shaping the coronal 1/3 of the canal creates sufficient space to passively accommodate rotary instruments or the taper of hand files, used to ultimately clean and shape the apical extent of the root canal system. This also allows sufficient space for an irrigant to suspend debris and clean the canal. Remember, the goal of canal instrumentation is to shape the canal to facilitate irrigation and subsequent root filling (obturation). Moreover, root filling is designed to seal the periapical region from the root canal and to entomb any remaining bacteria with the dentin tubules. Multiple studies have shown that mechanical instrumentation alone will not sufficiently remove pulp tissue and bacteria (2). Many root canal diameters are larger than the instrument caliber thus contributing to inadequate cleaning by instruments alone. Conversely, studies have shown that canal debridement and disinfection alone is still unacceptable by means of vacuum device or hypochlorite perfusion technique of the root canal system (3). Ultimately, optimal root canal debridement /disinfection requires a chemo-mechanical approach to achieve clinically successful outcomes.

Ideal Irrigant

The ideal irrigant has not yet been developed but must have properties that aid in both the debridement and disinfection the root canal system (4,5). This following is a list of desirable properties for a root canal irrigant:

- Capacity to dissolve tissue within the complex anatomical spaces of the root canal system.
- Broad antimicrobial spectrum and exhibit a high efficacy against anaerobic and facultative microorganisms organized in the biofilms.
- Ability to inactivate endotoxin.
- Prevent the formation of smear layer during instrumentation or dissolve the smear layer once formed.
- Non-toxic, non-carcinogenic, non-antigenic and cause no damage to the structure of dentin.

Over all, the irrigant selected must balance possible tissue toxicity and negative effects on dentin with its antimicrobial activity and tissue dissolution efficacy (6).

Sodium Hypochlorite (NaOCl)

Compared to all other currently used substances, sodium hypochlorite remains the most ideal irrigant (4, 5, 7). It covers more of the requirements of an ideal irrigant than any other known substance.
NaOCl is a non-specific proteolytic agent, which exhibits an excellent capacity to dissolve necrotic tissue as well as other organic components of the smear layer. NaOCl has a broad spectrum antimicrobial effect at concentrations from 0.5%-6%. It is the only irrigant that has been shown to kill endodontic pathogens organized in bio-films and in dentin tubules (8). Moreover, it exhibits the strongest antifungal effect (7) of all root canal irrigants or medications, it inactivates endotoxins (9), and is relatively non-toxic at lower concentrations.

The effectiveness of NaOCl to kill bacteria greatly depends on canal preparation and apical delivery of the irrigant. It is important to replenish NaOCl frequently, as its antimicrobial properties rely on the presence of free chlorine from dissociation of NaOCl (4, 7). It is the free chlorine that is consumed during tissue breakdown. Therefore, copious flushing with large volumes of irrigant is recommended to keep available chlorine level high. Irrigant techniques play an important role in canal debridement. Side deliver endodontic needle must be used within 1-2 mm of working length to effectively clean and debride the apical extent of the canal (10). Negative pressure irrigation techniques (EndoVac) have been shown to improve canal cleanliness and lower the livelihood of irrigant entering the periapical tissues (11).

There is much controversy over the concentration of NaOCl solution used in endodontics. Concentrations of 3%-6% have been shown to maximize tissue dissolving and antimicrobial effects. Overall, the antimicrobial effectiveness and tissue dissolution effectiveness is a function of the concentration of the sodium hypochlorite solution, but so is its toxicity. Multiple concentrations have been studied (0.5, 1.0, 2.5, 4, 5.25%) and the majority of American Endodontists use full strength 6% sodium hypochlorite. However, severe irritations have been reported when concentrated solutions have inadvertently been forced into the periapical tissue or have leaked through the rubber dam. Moreover, several studies have shown that higher concentrations (5.25%) of NaOCl significantly decrease the elastic modules and flexural strength of human dentin (12). This has led many authors to suggest lower concentrations (1.0%-3.0%) to balance the possible tissue toxicity with antimicrobial and tissue dissolution efficiency.

One way to improve the efficiency of low concentration NaOCl irrigants is to increase the temperature of the solution. The capacity of 1% NaOCl at 45°C to dissolve pulp tissue was found to be equal to that of 5.25% solution at 20°C (13). Another proposed approach is the ultrasonic activation of NaOCl resulting in cavitational effects and superior canal cleanliness. These effects have been studied extensively and authors feel the effects of ultrasonic activation, if any, were minor (4).

**EDTA (ethylenediamine tetraacetic acid)**

EDTA (10-17%) is a weak acid and chelator that reacts with the dentin to remove inorganic material (smear layer). EDTA, when used with NaOCl, is capable of removing the smear layer. NaOCl is needed to dissolve and remove the organic component of the smear layer, while EDTA will remove the inorganic portions of the smear layer (14). This results in improved cleaning and increased diameter of the dentin tubules. The removal of the smear layer will allow improved adaptation of obturation materials to root canal dentin.

However, it has been shown that EDTA reacts strongly with sodium hypochlorite solutions and will reduce the available chlorine in solution (15, 16). Therefore, EDTA should not be used in an alternating irrigating regime during canal instrumentation and its role lies as a final root canal rinse. Current recommendations suggest a 17% solution of EDTA be used after root canal shaping procedure is complete for one minute (4). Moreover, after smear layer removal, a final rinse with a low concentration of sodium hypochlorite solution appears to be beneficial to eliminate any exposed collagen, secondary to dentin dissolution by EDTA, that could harbor E. faecalis (17, 18).

**Chlorhexidine**
Chlorhexidine gluconate (2%) is a broad spectrum antimicrobial agent that has been advocated as an alternative root canal irrigant primarily due to its relatively low toxic effects (19). Chlorhexidine has a desirable "substantive antibacterial effect" which refers to its ability to bind to dentin and resulting in sustained antimicrobial activity for up to 12 weeks (20). However, chlorhexidine cannot be advocated as a main irrigant in endodontic therapy as it is unable to dissolve tissue, is less effective against microbes within a biofilm and less effective on gram-negative bacteria than on gram-positive bacteria (21). Chlorhexidine's role in endodontic irrigation remains as a rinse prior to obturation, alternative irrigant during retreatment cases or the incorporation into an intra-canal medicament (4). It should be noted that a brownish-red precipitate will form if NaOCl remains in the canal when chlorhexidine is added (4, 22). This precipitate significantly reduces the patency of dentin tubules, may affect sealing of the root filling and contains parachloroaniline (PCA). PCA has been shown to be toxic and carcinogenic. Therefore, to prevent the formation of PCA, alcohol or distilled water can be used to remove remaining NaOCl, along with drying the canal with paper points, before irrigation with chlorhexidine (4, 22).

Suggested Irrigation Regimen (4)

It has been extensively published that sodium hypochlorite solutions should be used throughout instrumentation, without alternating with EDTA or other solutions, to offer optimal tissue dissolution and bacterial destruction. The canal(s) should be irrigated with copious volumes of hypochlorite solution between instruments and the canal(s) should be kept full with solution to increase contact time with the solution. EDTA is used to remove the inorganic component of the smear layer and is the preferred rinse, using 5-10ml of 17% aqueous EDTA solution, for at least one minute (23).

Chlohexidine can be used in re-treatment cases to offer additional disinfection with substantivity as a final irrigant/soak for 30-60 seconds prior to obturation.

References
Current concepts in apexification

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Traumatic injuries in young patients can result in an interruption of root development and apical closure. If the pulp remains vital, the root and apical closure will either be accomplished normally, or may, if necessary, be induced by apexogenesis. Apexogenesis is the therapeutic process which permits the inner and outer enamel epithelium to continue to proliferate to form Hertwig’s epithelial root sheath, which plays a vital role in the differentiation of odontoblasts from the cells at the periphery of the dental papilla. This structure, and its associated root formation, progresses in an apical direction until complete formation of the root occurs.

When a tooth with incomplete root formation suffers from pulp necrosis, root development ceases and apical closure does not occur. Endodontic treatment at this time presents several challenges. The lack of an apical stop makes adequate obturation virtually impossible. The thin walls of the root canal are fragile and prone to fracture, and debridement is often difficult as the root canal and apical diameter are often larger than the coronal access diameter.1

In these instances, apexification is the alternative to extraction. Apexification is a method of inducing the formation of a calcified barrier in a root with an open apex or the continued apical development of an incompletely formed root in teeth with a necrotic pulp. This procedure involves the removal of inflamed or necrotic pulp from the root canal, disinfection of the canal and creates an environment favorable to closure of the apex. The goal of this procedure is to provide a hard tissue barrier that will provide an apical stop for effective obturation of the canal allowing the patient to retain the tooth.

Traditionally, numerous materials have been used to accomplish apexification. These include calcium hydroxide in combination with sterile water, saline, local anesthetic, methylcellulose, zinc oxide paste with cresol and iodoform; antibiotic pastes, tricalcium phosphate, collagen calcium phosphate gel, as well as growth factors and bone morphogenic proteins.4 There have been a few reports that have shown apical closure by the control of infection alone. Overall, calcium hydroxide, in a variety of mixes is the material most commonly used for the induction of a hard-tissue barrier in non-vital teeth.

Despite it’s long term use in human dentistry and generally reliable success in the induction of apical closure, calcium hydroxide has some disadvantages. The success rates of calcium hydroxide for the induction of apical closure in immature non-vital permanent teeth has been reported at 79-96% and in some instances was not successful in the closure of the apex. Radiographic evaluation in some instances has not been reliable.2 The variability in treatment time, the mean length of time for the induction of apical healing (in humans) in a summary of ten studies was 5.1-20.2 months.9 This has lead to many recommendations on frequency of calcium hydroxide dressing changes. However, there remains no consensus as reports range from a single application to changes of the intracanal dressing every 1, 3, or 6 months until an apical barrier is formed.8, 9 Delayed treatment complications include an increased incidence in tooth fractures, and apical periodontitis from leakage of the temporary restoration during the course of treatment.19 Moreover, difficulties in patient follow-up have resulted in incomplete or extended therapy. Calcium-hydroxide-based therapy requires a commitment from the client to return for regular clinical and radiographic follow-up visits to ensure long term success. Any single factor or combination of factors may lead to ultimate failure of therapy. Mineral Trioxide Aggregate (MTA) has become a common alternative to the traditional treatment practices with calcium hydroxide. Current literature supports it’s efficacy in several procedures.
including apexification or as a root end filling material for root end closure of non-vital teeth with open apices. MTA is biocompatible, bacteriocidal and able to set in the presence of moisture or blood. It exhibits good sealing properties and the regeneration of periradicular tissues including bone and cementum cells. MTA has shown high clinical and radiographic success as a material to accomplish root-end closure in immature teeth and therefore is a suitable or the preferred replacement for calcium hydroxide.

When MTA is used orthograde to accomplish root end closure it does not fit the definition of apexification. There is not direct induction of a calcific barrier in the root or continued apical development but, rather, a therapeutically placed apical barrier. The advantage of the apical barrier technique lies in the expedient cleaning and shaping of the root canal system, followed by the nonsurgical compaction of a biocompatible material into the apical end of the root canal thus creating an apical barrier that allows for timely obturation of the root canal and permanent restorative therapy. A number of studies have evaluated the apical seal obtained by MTA. In these studies, MTA has shown a superior apical sealing, compared to IRM, Super EBA, and amalgam and superior hard tissue formation when compared to calcium hydroxide. Moreover, MTA results in an adequate seal of the root canal that prevents bacterial leakage and interaction with the periradicular tissues. In fact, MTA has been used successfully to promote apical healing in failed infected root canal systems as well as failed calcium hydroxide attempted cases. Its mechanism of action likely lies in the fact that bacteria are sealed out and the material itself is quite tissue compatible; allowing undifferentiated cells to transform into mature fibroblasts, cementoblasts and osteoblasts to reform the apical dentoalveolar apparatus.

Instrumentation and disinfection of a non-vital tooth with an immature root apex presents a challenge to the clinician. Since the access site of immature teeth is commonly smaller than the root canal system, it is essential to consider the role of chemical support in the mechanical debridement of teeth with an immature apex. One of the main goals in endodontic therapy is the elimination of microorganisms from a contaminated root canal system. The ideal irrigant has been described as an agent that will both debride and disinfect the root canal system with sustained antimicrobial action. It should act a lubricant, dissolve tissues left within the complex structure of the canal, be non-toxic, non-antigenic, and non-carcinogenic. The irrigant selected must balance the possible tissue toxicity with the antimicrobial and tissue dissolution efficacy. Sodium hypochlorite solutions are the most widely used endodontic irrigant and has shown excellent tissue dissolving and antimicrobial properties. Many reports advocate the use of sodium hypochlorite (0.5-5.25%) in teeth with open apices. Sodium hypochlorite will attack the necrotic/inflamed tissue along with the predentin before it will affect live tissue that is supported by a vascular system, having a buffering/neutralizing capacity, along with viable cells and fibers. As the sodium hypochlorite solution acts upon the debris in the canal it is being neutralized and has limited capability to inact further. Therefore, it should be used gently and replenished frequently. Some authors have expressed concern over sodium hypochlorite irritant effect on periapical tissues. Chlorhexidine gluconate has been suggested as an alternative irrigant because it offers excellent antimicrobial effects and remains relatively non-toxic. When compared to 4% sodium hypochlorite, chlorhexidine (0.2%-2%) is significantly less effective as a canal disinfectant, but is less cytotoxic than 4% sodium hypochlorite. However, since chlorhexidine demonstrates no tissue dissolving properties, sodium hypochlorite will generally be considered the irrigant of choice. In human dentistry, it is common to perform cleaning and shaping followed by an interim dressing of calcium hydroxide paste placed into the canal. The dressing aids in canal debridement and will serve as an effective antimicrobial agent when left in the canal for at least 1 week. The canal is re-entered, irrigated with of sodium hypochlorite and MTA is placed. This is the technique recommended by the manufacturer although a recent publication has shown that after standard instrumentation and
placement of an apical plug of MTA, regardless of the previous use of calcium hydroxide, has favored apexification and periapical healing. MTA is composed primarily of tricalcium silicate, tricalcium aluminate, tricalcium oxide and silicate oxide. It is a hydrophilic powder that sets in the presence of moisture over several hours. The manufacturers' recommendation is to place a moist cotton pellet on top of the MTA for a minimum of four hours and proceed to obturation after 4 hours or at the next appointment. Previous publications and personal communication with several endodontists indicate that MTA will set appropriately as the tissue fluids would also serve as a source of moisture necessary for the setting of MTA in this patient. Clinical studies suggest the preferred apical extent of the MTA plug should be level with the radiographic apex22, 21, however, cases in which the material is slightly extruded beyond the apex cementum has formed around it. Orthograde delivery of MTA is considered technique sensitive. Current research has shown improved intracanal delivery and improved integrity of the MTA plug if ultrasonic instruments are used. The two-visit apexification technique allows for obturation 4 hours after placement of the MTA plug or the following day. Obturation with thermoplasticized gutta percha is the most common obturation method used in human and veterinary dentistry for teeth that have undergone apexification. Current literature supports a one-visit apexification technique in which an intermediate layer of a dual-cure glass ionomer is placed immediately coronal to the MTA barrier. This allows for immediate obturation with thermoplasticized gutta-percha or a bonded composite resin. Research shows that MTA will absorb the necessary moisture to allow for adequate setting from the periapical tissues while the glass ionomer will act as a rigid barrier for the timely obturation to occur. Apexification cases involving the use of composite resin materials placed immediately coronal to the MTA have shown an increased fracture resistance and more favorable long term prognosis. In a study comparing intracanal composite resin or gutta percha and sealer placed after a 4 mm MTA apical plug, the composite resin treated group showed significantly greater resistance to root fracture.40 Another study showed that a Luminex resin-reinforced dowel system could offer 50% more resistance to fracture than conventional post and core therapy. Finally, in a study involving teeth that had undergone apical barrier therapy with an MTA plug, there was a similar fracture resistance between roots filled with saline and those completely filled with MTA thus there is no advantage of complete obturation with MTA for root reinforcement.17

Conclusion
Many factors contribute to the selection of an apical barrier technique using Mineral Trioxide Aggregate (MTA) as alternative to the traditional treatment practices with calcium hydroxide to achieve apexification. They include the reduction of the number of necessary anesthetic procedures, reduced cost to the pet owner, the predictable development of an apical seal, and MTA's demonstrated ability to induce the deposition of hard tissue. Moreover, this technique allows for completion of the case in an efficient way allowing the permanent restoration to be placed in a timely manner, thereby reducing both the incidence of tooth fracture and re-infection of the root canal.

References available on request.
Surgical endodontics

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Indications:

- Failed standard root canal (Figure 1)
  - If you feel that you cannot perform a better conventional
  - Poor standard root canal therapy is no reason for surgical

Procedural blockage

- Pulp stone
- File separation
- Stenotic canal (try RC prep and watch-winding first!)

Incomplete apex

- Young patient
  - Prefer apexogenesis or apexification first

Apical perforation or apical disease/resorption

- Only if severe, these can often do very well with standard root canal therapy

Equipment needs:

There are several critical pieces of equipment that are required to perform this type of therapy. These include: a dental x-ray unit, high speed air driven unit preferably with a pediatric (mini) hand piece, a sterile surgical pack (scalpel, periosteal elevator, needle holder, burs(701, 330, 1/4), and root end filling material (MTA, IRM, amalgam).

Ideally, an ultrasonic root end preparation tool should be available for the root end preparation as it will facilitate the procedure as well as improve the success rate (see discussion below).

There are several models of ultrasonic retrograde preparation tools. All of these are excellent at performing their given task. However, there units can be quite expensive, especially when the relative infrequency of surgical endodontics in veterinary practice. Therefore, there are tips designed for the piezoelectric ultrasonic scalers that exist in most practices. For a very small investment, these can be obtained so that when the need arises, they are available.

Pre-operative testing:

A minimum database should be obtained consisting of a CBC and chemistry panel including thyroid level in older patients as well as a urinalysis. In addition, this author recommends that patients over 6 years of age have 3-view chest radiographs exposed. Finally, a coagulation profile and Crossmatch should be considered.
Since this is a very invasive procedure, IV Fluid therapy, balanced anesthesia, and proper pain control (NSAIDS, Opioids, regional anesthetic) and antibiotic coverage, along with monitoring should be performed in all cases.

**Surgical procedure**

Approach:

The incision should be placed utilizing your knowledge of dental anatomy and palpating the juga (if possible) to approximate the apex. Make a curved incision to expose the apex by a wide margin avoiding the attached gingiva. The incision should be made full thickness in one deft motion to enhance healing. Following the incision, the mucosa should be elevated full thickness to reveal the bone over the apex. If there is any question as to the location of the apex, the practitioner should consider placing a radiopaque marker over the apex and exposing a radiograph to ensure that the trephination is in the correct position.

Using a dental bur, the bone is carefully removed to expose the apex. This should be done in a paint brush fashion. Once the apex is identified, it is further exposed for the surgical approach. Enough of the root must be exposed to reveal 6-8 mm of the apex plus a little beyond. This bone removal must be done very carefully to avoid damaging the root or entering vital tissues (nose, mandibular canal).

Apicoectomy:

Once the apex is exposed; using a high speed bur (699 normally) resect the apex. It is important to remove a minimum of 4 mm of apex in order to minimize the possibility of lateral or accessory canals. If you are performing the retrograde preparation with a bur, the apicoectomy should be done at a 45 degree angle to help visualization. If utilizing an ultrasonic retropreparation tool the cut should be performed at a 90 degree angle. In fact, the 90 degree angle provides superior seal to the traditional 45 degree angle when ultrasonic units are used to prepare the cavity\(^3\). The granuloma should be debrided with a curette and a sample submitted to the lab for histopathologic analysis. Following this, the defect is rinsed and packed with cotton pellets to help catch scatter.

Apical preparation:

The apical portion of the root canal system is then prepared to a minimum depth of 3 mm.

This was classically accomplished with a small round bur. The bur is placed into the canal and carefully moved coronally, ensuring that the GP is completely removed. In tight spaces, a slot of matzuri may be necessary to achieve an acceptable fill.\(^1\)

For ultrasonic preparation, the reotip is then placed on a moderate setting and gently tapped into the obturative material. The tip is moved in all directions in and out and up and down until the canal is prepared to the selected depth (minimum of 3-mm). It must be noted, that there will be no undercut created during ultrasonic debridement.

Therefore any filling material that requires mechanical retention (i.e. amalgam) will require additional bur preparation. The expanding use of MTA makes this a mute point in most operatories.

Retrograde filling:
Following the preparation, an intraoperative radiograph is recommended to ensure complete removal of filling material to an appropriate depth. In addition, it is further recommended to employ a periodontal probe to ensure that the preparation is of sufficient depth. Providing that the radiographic and physical evidence of proper preparation exists, the apical portion of the root canal is filled.

Amalgam, IRM, and EBA have been used historically; however MTA is the current treatment of choice. If there is severe inflammation and seepage, MTA use may be a concern due to the moisture. The selected material is placed with a retrograde filling instrument and packed into the canal to fully and densely fill the canal. The canal should be completely to slightly overfilled with a minimum of splash. If there is any concern of proper fill, a radiograph should be exposed at this time.

Closure:

The cotton pellets are removed and the area thoroughly cleaned and debrided. The defect is packed with an osseopromotive substance and the incision closed normally. If a post-operative radiograph has not been exposed, one should be at this point.

Post-operative Care:

Proper pain medications and antibiotics are prescribed and the clients instructed to feed only soft food for 2 weeks.

Recheck radiographs in six months are critical to ensure success of the procedure.

The case for less surgical trauma, increased root retention, and less aggressive cavity preparation is made by several different factors.

Discussion:

There are numerous reasons that ultrasonically prepared root end fillings are superior to those created with a carbide bur. These are detailed below.

First, the apicoectomy does not need to be performed at a 45 degree angle as access is much easier using these instruments. This decreases the amount of root structure that must be sacrificed in order to restore the root end. In addition, a right angle prep is simpler to perform than a 45 degree angle in this author's hands due to the fact that the depth is easier to gauge. A 90 degree angle has also been shown to decrease microleakage when compared to 45 degree angle preps.

Less apical bone needs to be removed when utilizing ultrasonic reotips. This is due to the 90 degree apicoectomy as well as the fact that there is no need to create room for the head of a high-speed bur beyond the apex of the tooth. This can be of critical importance in some instances where the increased removal may result in the compromise of the mandibular or infraorbital canal and the associated vessels and nerves.

The retroprep is considerably smaller when utilizing ultrasonic reotips than when utilizing a bur. This is due to the ultrasonic tip will more selectively remove the obturative material without indiscriminate removal of critical root structure.
The combination of these three factors results in much less surgical trauma as well as retaining more root structure, thus increasing retentive ability.

Studies have shown that the preparations achieved by ultrasonic preparations are less contaminated compared to bur preparations in several ways.

They have a much decreased smear layer compared to conventional preparation. Smear layer is a big concern in conventional endodontics as it interferes with the bonding ability of the sealant and restorative materials. This concern is of equal or greater importance in surgical endodontics as the restoration is only a few millimeters in depth.

In addition, scanning electron micrograph examination of prepared canals revealed that those prepared with ultrasonic instruments were cleaner than those prepared with burs. This increase in cleanliness is obviously important clinically.

The cavitation produced by ultrasonic instruments is a known antimicrobial method. This has been shown in numerous studies in both the standard endodontic and periodontal disciplines. In fact, the ability of these instruments to “sterilize” plaque is the basis of the perio BUD theory of periodontal therapy (controversial).

Finally, it has been noted that ultrasonic preparation creates deeper and more parallel preparations with increased retentive ability. This results in improved seal at the apical portion.

The combination of a cleaner and more sterile canal with less smear layer results in a superior seal of the retrofilling and therefore a more favorable prognosis. This superior seal has been demonstrated in a controlled experimental study.

Many of these benefits are directly or indirectly responsible for the most important advantage of ultrasonic preparations over traditional bur preps: improved success rates. Studies have shown success rates of 96% (82% complete and 14% partial), 92.4%, and greater than 90% utilizing this method. This is in comparison to the 62% (57% complete and 5% healing), and 82% (71% complete and 11% partial) in those cases treated with burs. The one study that directly compared the two methods reported 85% complete healing in the ultrasonically prepared teeth and a 68% success rate in the group treated with traditional burs. Therefore this technique appears superior to traditional burs. The only concern with this conclusion is that all the rotary treated teeth in these studies will filled with amalgam, where as many of the ultrasonic treated teeth were filled with super EBA which has been shown to be superior to amalgam in other clinical trials. Therefore these studies should be evaluated in this light and we should look to future studies comparing similar root end fillings prior to making the final descion on the preferred method of root end filling.

Finally, there are statistically less perforated cavities in roots treated in this manner as opposed to burs. This is also likely due to the selective removal of obturating material. Reotips also appear to be able to follow the contours of the root surface better than burs. The result of the above will be fewer iatrogenic complications.

One possible negative of these instruments is surgical time. Some studies show that there is increased time involved when treating teeth with ultrasonic tips. Other studies reveal no significant change in time spent.

The major negative aspect of ultrasonic tips is that they appear to cause an increase in microcracks in the root end. This is concerning as it may increase leakage and promote failure. However it
appears that this damage can be minimized to negated by utilizing a low to moderate as opposed to high power setting.  

There is some discussion of the benefits of diamond coated vs smooth stainless steel tips. There is a feeling that the diamond encrusted tips are superior to smooth stainless steel tips. This has not been borne out in the studies to date. Studies show that preparations with smooth tips were cleaner and smoother than diamond encrusted tips. However, a different study reported that diamond coated tips created a superior cavity than smooth tips. These are likely less clinically relevant than the studies which revealed that the dye leakage was similar in the two groups. The one report noted that diamond coated tips appeared to be much more aggressive than smooth tips. This does speed the procedure, however at the risk of iatrogenic damage if not used with care. Therefore, either tip is acceptable, however at this point the limited to no advantage of the diamond coating does not appear to justify the increased cost.


Zuolo ML, Perin FR, Ferreira MO, de Faria FP: Ultrasonic root-end preparation with smooth and diamond coated tips.


Performing the Perfect Physical Examination: What to Say and How to Do It – The Doctor's Role

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Performing a physical examination is a part of nearly every patient interaction in a veterinary hospital. Too often we fail to recognize the vital role this service plays in creating value and confidence in our services. Further, how we perform and communicate our physical examination plays a large role in our compliance with recommended diagnostic and treatment offerings. While every doctor will have his or her own style and routine, it is important that the examination be methodical, efficient and conveys thoroughness and compassion to the client while keeping the pet as comfortable as possible. Step-by-step instruction of how to perform a physical examination is found in the staff training DVD “Creating the Veterinary Appointment” (2008 E³ Management Press – www.E3Management.com).

The Entrance

I believe the ideal physical examination begins with a warm entrance and greeting of the client and patient by names. I have all of our staff greet by shaking palms and paws. We then sit down and the technician reviews the pertinent medical history she has previously obtained. The doctor then asks any additional questions and we begin the examination.

The Physical Examination

General Condition, Ears, Eyes, and Nares

The technician gently lifts the pet onto the exam table. If the pet is large, we often perform the examination on the floor where a larger dog is often more comfortable.

I start by performing a body condition scoring (BCS) and assessing the pet’s general appearance.
make comments regarding the coat, stature, weight and overall state of appearance. I then move to examining the ears, eyes and nares and work my way back, articulating each part of the exam. It is very important that you explain each step and point out any abnormalities as you discover them. I start the examination with the pet facing me to gain better access to the head and neck. It is important that you have a logical examination flow that incorporates natural transition points. Transition points are opportunities to change orientation naturally so you appear coordinated and rehearsed. Without a well-thought plan of execution, your examination may appear haphazard and incomplete. Further, by training a coordinating with your staff, you avoid embarrassing gaffes such as bumping into each other or having to ask them to turn the pet back to you because you failed to complete an aspect of your examination. Whatever your desired flow, you should discuss and role-play it with your staff so that everyone is on-board and understands your methods.

I like to dim the lights as we start the exam by looking into the ears and eyes. This helps me in my examination and also reinforces the seriousness of the examination to the client. Dimming the lights is a natural transition point in that it takes the client from the previous ten or twelve minutes to talking and discussing their pet’s medical history to the action of performing the examination. We then create another natural transition point when we turn the room lights on again.

I recommend detailing your findings verbally whenever a client cannot see what you’re examining. This serves not only the client but the staff member assisting you as well. When your staff is involved in the examination, they can help you complete the physical examination report. While we use a video-otoscope in diseased ears and nares, for most routine examinations we use traditional otoscopes. Describe the retina, lens, conjunctiva, tympanum, nares and other pertinent structures. This reinforces to the client that you are performing a thorough and complete examination and are capable and competent. I use an ophthalmoscope followed by a halogen penlight to test pupillary light responses. After describing my findings, I use the penlight to illuminate the nares to assess patency, architecture, the presence of any discharge or other abnormalities.

**Oral Exam**

I then turn the room lights on as I begin the oral exam. Because turning the lights on is a visually dramatic step, it also helps change the level of involvement from the client. I ask the client to stand up (out of their chair) and come close to the exam table and pet to show them any problem areas. I want them to see and smell any periodontal disease. Many clients with pets that have advanced periodontal disease will not routinely look into their pet’s mouth. Many will actually avoid the oral cavity altogether due to malodor or unsightly appearance. I believe it is important to confront periodontal disease directly by having the client interact and see the issue(s). This doesn’t mean we should make your clients feel guilty; rather, it means we should be thorough and demonstrate
any areas of improvement whenever possible. Point out gingivitis, calculus, bleeding or inflamed gums, loose teeth and recessed gums. Have the client smell the breath and discuss the cause of the offensive odor (pathogenic bacteria). If the teeth and gums look healthy, take this opportunity to congratulate the client on their efforts. By actively engaging and interacting with clients, you’re more likely to impress upon them the seriousness of the condition. If a client remains physically distant and uninvolved from the oral cavity, it is much easier for them to ignore our recommendations for dentistry. If a veterinarian remains distant and uninterested, the client will assume that their own ignorance is justified. Make sure you lift the lip and take a whiff with each patient and client.

It is imperative to make the connection between oral health and systemic diseases such as endocarditis. Too many clients view dentistry as merely a cosmetic procedure and see no value in keeping their dog’s teeth “Hollywood-white.” It is our professional obligation to make sure clients understand the relationship between the mouth and general health and well-being. If you note loose teeth, discuss pain. If you see gingivitis, remark about gum recession, tooth root exposure and the potential to adversely affect adjacent teeth. It is important to keep in mind that few clients thoroughly examine their pet’s oral cavity at home. Take this opportunity to lift the lip and educate your clients on the dangers of periodontal disease.

One final note: I recommend that you point out and briefly touch on an abnormal finding during the course of the examination. I recommend that you reserve the more detailed discussion for the time after your examination when you review pertinent findings. Additionally, you can also have a trained staff member give more detailed information on conditions such as periodontal disease after you exit the appointment.

Lymph nodes and Skin

With the pet still facing me, I then feel all of the lymph nodes, all the while explaining what I’m doing and why. I start with the submandibular and work my way caudally. I create a natural transition point for turning the pet away from me as I palpate the inguinal and popliteal lymph nodes. The assistant turns the pet and I palpate these caudal lymph nodes. I next verify if the client had observed any new lumps or bumps as I run my hands along the pet’s body. I make sure to emphasize to the client to closely monitor the areas of the lymph nodes for any swellings as I feel the body. Any masses are noted and measured and we generally take a digital photograph of any sizable or suspicious masses to be included in the pet’s electronic medical record. If there are any new masses we strongly advise the client to have a fine needle aspiration performed and submitted to the laboratory for histopathological review.
Thoracic Cavity, Abdomen and Hindquarters

I then auscult the chest. I like to close my eyes to demonstrate my attentiveness and also as a signal to the client that it's time for quiet. I usually say to the pet and client that I'm going to feel their pulse as I listen to the heart. Again, this provides me with valuable information regarding pulse strength and quality and further enforces to the client that their pet is receiving a complete and thorough exam. After I auscult each quadrant of the thorax, I open my eyes and describe what I heard and then move to palpating the abdomen. I start in the cranial abdomen palpating the kidney(s), liver, spleen and bladder. I pay close attention the any structures that I feel are enlarged or abnormal in any respect. It is very important that you explain what you’re doing and why, especially when you are engaging in seemingly incomprehensible actions. I make it a point to describe what I’m feeling as I probe the abdomen. I also comment to the patient and client if there is any tenseness or apprehension as I palpate the abdomen. Some pets are more accepting of this procedure than others. If a pet is nervous or fearful, I must take great strides to calm both the patient as well as the client. If a client perceives that I am being rough or in any way less than gentle with their pet, I risk forever damaging my reputation and kind and compassionate. Often all that is required to allay even the most challenging fears is communication.

Once I’ve completed palpating the abdomen, I lift the tail to evaluate the rectum and hindquarters. While this is arguably the least glamorous part of the physical examination, it is critical that we are thorough. This includes the anal region. There may be an emerging perianal adenocarcinoma that will go unnoticed until the groomer sees it in two months.

Musculoskeletal System

The final step in my physical examination is the evaluation of the joints, limbs and paws. With the pet still facing away from me, I lift up and examine the rear paws and begin flexing and extending the joints as I progress toward the hips. Any withdrawal or tenseness is noted. I repeat the same for the front limbs. I end by putting the head through a normal range of motion by extending and flexing the neck up, down and side-to-side.

Reviewing the Examination

Once I’ve completed my exam, we replace the pet on the floor or in the carrier and I resume sitting on my stool. I pull close to the client, generally about 36 to 42 inches away and at a 45-degree angle to the client. I review my findings and outline a course of action. This is the time to discuss more fully the importance of weight reduction and oral care. I have found that by introducing a problem
area during the examination and then reviewing it more formally after the examination is complete, the client is much more receptive. It sends a clear message to the client when you take additional time and effort to revisit a particular area of interest concerning their pet’s health. It also improves your communication when you’re properly seated and without the distraction that a pet on the exam table may create. This discussion also reminds the assistant of topics you want them to enforce in the patient discharge. During this time the technician is filling out the physical examination report and taking notes or entering charges.

Once I’ve completed my review and outlined a plan, I ask the client if they have any questions and tell them we’ll be right back after we read any lab test such as fecal parasite evaluation or heartworm tests, finish their paperwork or get any recommended items. It’s important to maintain an open body posture at this time, facing the client as you prepare to leave. If you turn to the side or begin approaching the door, you’re sending a signal that you’re ready to leave. Before I exit the room, I make sure to shake palms and paws. I exit the room leaving the assistant or technician to tell the client what we’re doing and then they also leave the exam room.

It is important to keep the amount of time the client spends waiting at this point to a minimum. One to three minutes is about all it takes for the majority of routine examinations. In sick pets, the time spent performing and evaluating laboratory tests will be longer. Be sure to have a plan for dealing with patients that require radiographs, blood tests or more involved discussions.

**Technician Review of Examination Findings**

Up until this point, the client has had a staff member with them for the entire appointment. I like having a staff member ‘velcroed’ to the client because I find it is a great way to build trust, ensure that you thoroughly educate and answer a client’s questions and create continuity of care within this appointment. It also helps reduce missed charges and increase compliance and follow-up care.

The only time we leave the client alone is when the technician and doctor leave the room to get any additional paperwork or products and complete the written discharge instructions. It is critical that you are aware of the time you leave the client alone in the room. This generally takes us one to five minutes, depending on the complexity of the case.
Once I’ve finalized my examination report, the technician will return to the exam room and begin the discharge. We are now approximately twenty to twenty-three minutes into the appointment with seven to ten minutes to review the reports and recommendations and bill out the client.

The technician returns to the client and begins reviewing the doctor’s report with the client. My strategy is to repeat my recommendations three to five times during the appointment. This offers the most repetition and increases the likelihood a client will take our recommendations seriously and act upon them. Reinforcing a message through a variety of team members will help you improve your compliance with any service or product.

The first opportunity to offer medical advice comes when the technician is obtaining the medical history. For example, if she notes that a pet needs to lose weight, this is a great time to start the discussion of diet and exercise. The next opportunity occurs when I am performing the physical examination. If I observe stage two or three periodontal disease during the exam, I will recommend a dental scaling and polishing. The third chance to offer recommendations happens when I sit down and review my examination findings. The fourth and fifth opportunities take place when the technician goes over our written discharge report and when the receptionist reviews the appointment at billing.

By strategically reinforcing the care a pet needs with the client throughout the appointment, you’ll gain increased compliance and that means pets live longer, healthier lives.

Before the assistant enters the room to review the examination report, the first step is to double check the doctor’s report. This will help the staff member remember to get all of your charges in and make sure that there aren’t any typos or other errors. If there’s a problem, your staff should correct it before it reaches the client and causes embarrassment and diminished credibility. Even simple mistakes such as the wrong gender or age on an otherwise flawless report can be enough to create doubt in a client’s mind. Everyone, including doctors, makes mistakes and the team can help the doctors look good to clients. Doctors may forget that the patient was prescribed a drug or follow-up care and the technician will catch that mistake and that double-check helps reduce gaps in follow-up care.

The staff member then takes a seat and starts to summarize the written report. The assistant or technician should review the physical examination and comment on the normal findings as well as the abnormal ones. It’s important to point out where clients are doing well so any areas that need work don’t come across as a reprimand. The staff member takes a highlighter and highlights any test results or abnormal findings and also highlights any treatment or follow-up care instructions.
The highlighter helps personalize the report and allows the assistant to focus the client’s attention on what the client really needs to do for their pet.

**Time**

In the real world there is no set time for the amount of time obtaining a medical history, performing a physical examination, reviewing the exam report and billing will take. In general terms we allocate thirty minutes for the entire appointment with a third of the total time allocated to 1) Welcome, medical history and lab samples, 2) Physical examination, and 3) Reviewing the exam and billing. Some pets will require a longer history while others will require fifteen minutes to perform the physical examination. The key is to know your schedule and where are you in the appointment both from a time as well as procedural perspective. Five minutes is a long time if you’re staying on topic and discussing what the pet needs. Five minutes is a relatively short period if you’re discussing the weather or church and then realize you’ve neglected the pet’s obesity.

While there is no right or wrong way to perform a physical examination, I encourage you to develop a systematic approach that allows you to be as thorough as possible in as short amount of time as practical. Your clients will thank you for being through and compassionate and our patients deserve it.

For a training DVD that teaches your veterinarians and staff how to perform the perfect appointment, visit www.E3management.com.
The medical necessity of dental care for pets

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Dental care is very common in our practice. It is one of the first treatment performed and this highlight the well acceptance of “scaling” by owners. “Cleaning” teeth is most of the time a voluntary demand and is pretended as a safe and easy procedure.

By the way the owner concern steel remains halitosis. Offensive breath is the major reason to give dental care and pet cleaning teeth is confound or associated on mimic’s form of the owner oral health pathway.

Fortunately domestication put our small companion animals in the “human” conditions of life. Unfortunately aging will support the development of chronic pathology. The last century expended our knowledge on periodontal inflammations. It is absolutely clear that certain systemic conditions may enhance their development. The converse side of this relationship has been highlighted only over the last ten years. Evidence emerging has shed light on the potential effects of periodontal inflammations on a wide range of organ systems.

Then demonstration that Oral care is effective in prevention for chronic inflammatory process away from the oral area start from now to be a reality. This assessment is accepted for pregnancy outcome, chronic obstructive pulmonary disease, diabetes mellitus, coronary heart disease and arteriosclerosis, and at the end an incidence on overall mortality in human medicine. Those statements start to be demonstrated in veterinary medicine.

Periodontal inflammations are infectious diseases. They are diagnosed as focal infections even then they can spread through facial tissue in some occasions. With time these focal infections promote Gram negative colony development and their potential bacteraemia. At this stage presence of endothelial damage, cytokines and growth factor stimulations conduce to several damages: vessel wall thickening, thromboembolic events, increase insulin resistance, increased amniotic prostaglandin production...all these parameters are associated with inflammatory factors diffusion via the general blood stream.

From now, when we do perform a “scaling” in our clinical practice....our medicine knowledge should be in alert!
Periodontal inflammations are also painful lesions and this statement is observed with evidence on severe forms of chronic inflammation and on all stages of an aggressive inflammation. Pain is most of the time difficult to assess on pets. But pain is always a source of concern for owners and it is easily demonstrated after efficient application of an efficient periodontal treatment plan.

Dental cares for pets should not be considered from now as a simple cosmetic necessity.

Poor dental care leads to serious health issues that can affect the pet’s entire body if left unchecked. Besides permanent tooth loss and its functional consequence, periodontal diseases lead to inflammatory factors spreading away from the mouth.

When we propose dental care services we also propose a medicine service with prevention of the development of severe facial pain and vital organs fibrosis.
The Difference between a "Dental Cleaning" and a Professional Periodontal Treatment

Nicolas GIRARD, DVM.
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We have to accept that our domestic pets do not brush their teeth regularly and do not still have the possibility to consult their favourite dentist ...

It's with any surprise in these conditions to observe the prevalence of periodontal diseases: 61% of cats support a moderate form of periodontal attachment loss and 21% a severe form, according to a study in a colony of healthy cats (Girard, Servet, 2009); 90% of the dogs of less than 4 years support early stage of periodontitis and 85% of the dogs of more than 12 years a severe stage according to a study led on poodles in specialized clientele (Hoffmann, 1996).

Dental treatments are not only a “cleaning” concern but moreover the therapeutic management of a mouth in poor condition. This statement is essential to a good periodontal treatment understanding.

**The support of the consultation room is the first step.** The diagnosis and the forecast of the periodontal inflammations should be discussed during a specific appointment. Its treatment must be planned with the owner. This plan must resume the surgical procedures, the rules of hygiene, the food advice necessary for the implementation and for the maintenance of a good oral health. The therapeutic orientation given is often a function of the capacity and the motivation of the owner to accept the main lines of said plan. The conservative cares are conditioned by the acceptance of elementary rules of oral hygiene.

The consultation is neglected most of the time but lives nevertheless the fundamental part of the treatment. It is more than precarious to schedule dental treatment without having analyzed beforehand the gravity of the oral lesions. The acceptance of the care is conditioned by a complete clinical analysis associated with the appropriate medical translation: pain and infection. Therapeutic orientation: the speech must always be positive. Control periodontal inflammation lead to the control of facial pain and infection. This message has a great impact when final decision is in balance. Phase of maintenance: the role of the owner in the post operative stabilization of the oral
inflammation must be advanced. The dental plaque develops in 24 hours what implies the management of care at regular intervals.

Medical prescription: the second step

Antibiotic management/ pathogenic bacteria stemming from the dental biofilm scatter by blood, digestive and/or respiratory pathways. The implementation of an antibiotic prophylaxis aims at limiting this risk and should be schedule with a patient "to risk". Risk is defined by the presence of a chronic metabolic associated disease (Cushing, Diabetes), by a cardiac insufficiency, by a renal insufficiency, the presence of artificial or ophthalmic joint, of an acquired or supposed immunodeficiency (Collie, Persian blue).

Therapeutics antibiotic/ its indications are: tumefaction of fast progress; diffuse tumefaction (phlegmon); damaged immunizing status; diffusion in a facial area; osteomyelitis. An antibiotic must be used when there is a clear evidence of infection of underlying tissues, the development of which is up to the capacities of defences of the host.

Antibiotics must be used to assist the dentist in his care.

Pain management/ a good understanding of the pathways of pain is essential to allow a comfortable wakeup from anaesthesia. Multimodal analgesia technique should be used and monitored during the periodontal treatment plan.

Dental treatment: the third step

Asepsis: the effective sterilisation of the equipment is important following every treatment. A solution of chlorhexidine (0.12-0.2 %) is used on the operative area to realize the pre operative oral antiseptic.

Supra gingival scaling: the tartar blocks are removed with forceps and/or curettes, to avoid a superfluous waste of time in the first operating time. Then we use sonic or ultrasonic hand piece to perfect the scaling. The sharpness of the insert’s tip improves their precision. The frequency delivered at the end of the explains the very big efficiency of these instruments although their work plan on the crown surface is more or less parallel with the axis of vibration of the insert.

Radicular curettage: this is the most neglected part of the treatment and it represents the essential stage of the treatment plan. It consists in the elimination of the tartar and the dental plaque under the gingival level. The curettage requires operating time, accuracy and rigor. The healing of the periodontal ligament requires the highest efficiency. Those dental cares are most of the time blind realized. Periodontal curettes are traditionally used to unstick the sub gingival plaque deposit. According to the scale of the curettage the superficial part of the cement is eliminated. Hand curettes are nowadays questioned further to the advent of the subgingival sonic and ultrasound
technologies. The use of specific inserts, adjusted in well defined amplitude, allows the realization of subgingival dental care the quality of which is the equal of those realized by means of manual curettes. The training of inserts techniques turns out much simpler towards manual curettes. Both described techniques are often associated within the framework of deep pocket to win in efficiency and in operative time.

Dental extractions: they are actively involved of the treatment of periodontitis. Multirooted teeth are split so many roots to facilitate the extraction of the various parts. In case of particular difficulty, we realize an access flap which allows the access to the underlying alveolar bone. Ostectomie and localized osteoplastie facilitate the mobilisation and luxation of root tips.

Gingivectomie and gingivoplastie: gingival hyperplasia is the only clinical situation periodontal surgery could be easily performed in first intention, as gingival hyperplasia does not modify the periodontal attachment. All the abnormal tissue must be excised to facilitate the clinical access to the crown.

Polishing: Specific dental pumice applied by means of a rubber cupule on a low speed contre angle, allows polishing micro crevices generated by the scaler.

**Home care: the final step**

Daily dental brushing insures 70 % efficiency on the reduction of the dental plaque. The gingival massage bi daily, by means of a gel containing of the chlorexidine under an effective galenic shape, allows a reduction of 40 % of the dental plaque.

Specific food supply incidence does not exceed 20 % of efficiency on the reduction of the dental plaque. However, they preserve their clinical interest if their limits are well explained to the owner.

Phase of maintenance: regular recheck are essential to assess the level of the gingival inflammation. Some owners are strengthen in their ability to perform appropriate oral care and pleased to observe the control of the periodontal inflammation.

A good understanding of the periodontal disease is essential to advise efficiently our clients.

The results obtained are very satisfactory most of the time. We should not forget that they rest on a physiological intra oral balance. The slightest failure may lead effectively to an important recurrence: the motivation of the owner is often at the end the key of the success.
Did You Brush Your Teeth? Strategies for Compliance and Follow-up Dental Care

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Despite our best recommendations, the fact is that few clients provide proper dental care for their pets. What can we do to encourage client compliance and maximize the sale of dental care products in our practices? Fortunately, there are many methods to promote dental care to our clients. From personal testimonials to take-home client educational materials to product placement in your clinic to social media, text messaging and emails, there are many strategies to enhance our patient’s well-being and our practice bottom line.

Practice what you preach

*Your client recommendations will resonate better if your own pets receive the best medical care.*

In my humblest opinion, this is simply the right way to practice veterinary medicine. When you make recommendations, you can look your clients in the eye and say, “This is what I do for my own pet.” And you can really mean it. This philosophy should be applied to all of your staff. What type of care do they provide for their own pets? Their own belief and habits will have tremendous influence on not only what they consistently recommend, but also on how well those recommendations will be perceived by your clients.

To verify you’re recommending the right services to clients, look at 10 random medical records at your practice and see if you or another veterinarian recommended the standards of care appropriate for that pet. Clients can’t comply with recommendations they don’t receive.

In addition to receiving recommendations, clients need to know that your standards of care are important and that your own pets receive the care you recommend. “Your testimonials and recommendations will resonate on a much deeper level for clients when your personal pets are in compliance.

Remember, though, the moral of this story is not guilt—it’s self-improvement. Like everybody else, you get busy and things fall by the wayside. But now’s the time to be completely honest about your client recommendations and your personal compliance.
Don’t beat yourself up. Keep growing. A veterinarian who’s forgotten heartworm preventive for their dog isn’t a bad pet owner.

**Client Educational Materials**

*Make them your own to connect with clients.*

According to industry estimates, the average western European or American will be exposed to 500 to 1500 advertising messages each day. Of course, the vast majority of these will be ignored completely, but still, that’s a lot of advertising! In the veterinary clinic we must be careful which advertising messages we expose our clients to and why they are necessary. One of the best strategies for communicating the importance of a product or service is to create your own educational materials. In simplest terms, take the manufacturer’s flashy brochure and re-work it into your own language, style and voice. For example, let’s examine a new dental product. Instead of simply handing your clients the slick brochure, hand them a one-page handout written in your own words about the importance of such a product along with the product brochure. This will demonstrate to your clients the importance of this product (or service) and gives a personal endorsement rather than “just another advertisement.”

**Put People First, Paper Second**

*Educational handouts are more likely to be read when they’re explained first.*

Too often, salespeople will take the approach of “You can read all about it in this handout.” Rarely will that material receive more than a casual glance. To improve the odds that your educational materials will actually be read by your clients, try this simple approach: Whenever you’re giving a client a handout, pause before handing it to them. Review the information in the handout in your own words first. When you’re done, tell your client, “Everything I just discussed is in this handout for you to review when you return home. Feel free to call me if you have any questions.” Put people (discussion) first, paper (handouts, brochures) second.

**Location, Location**

*Where you display dental products has impact on sales.*

Ask anyone in retail sales where they want their products to be and they’ll tell you, “In front of the consumer.” Now ask yourself where your top recommended products are located within your clinic. Dental products should be grouped together whenever possible. Eye level is ideal although as high as practical within your clinic will suffice. The products should be labeled whenever possible (i.e. “Dental Care” or “Toothpastes”). An information card attached near the products explaining what the product is and how to use it is also an excellent idea. All products should have a price clearly visible. Items without prices are seldom purchased for fear of embarrassment. No one wants to ask a staff member how much something is and then replace it on the shelf if it is more
expensive than they wish to pay for it. These products should also be placed fairly close to the area where clients pay because a large percentage of sales are impulsive.

**Improving Compliance: Going beyond “Yes” and Getting to “Do”**

*Getting a client to adhere to recommendations takes more than simply agreeing with us.*

Gaining the trust and confidence of our clients is a critical component of acquiring compliance. Survey after survey reports that our clients trust us, yet our overall compliance rates remain low. The next step toward improving compliance is moving beyond a client’s acceptance that a recommendation is valid and justified and getting them to act upon that recommendation. Once a compelling message has been created, there are several steps we can take to ensuring that our clients comply with that message.

**Step 1 – Follow-up Communication**

Let’s say you and your doctor just spent thirty minutes explaining the importance of having a pet’s teeth cleaned with a client. How do we track if our message really sunk in? Further, how do measure if we’ve spent our time wisely? Follow-up communication is a vital link in the process of compliance. The first step is to review your invoice reminder set-up for a given code. Is a periodontal disease diagnostic code linked to a follow-up telephone call, email reminder or postcard? If not, how can this best be accomplished within your practice management software? You may need to create an invoice code such as “30-day Dental Cleaning Call” and enter this code on the invoice of each pet you recommend a dental cleaning that is not scheduled at the time of discharge. Many software programs allow you to enter a diagnostic code and then you can perform a monthly query to search for all of the pets with this diagnosis and send them a targeted email, text message, postcard or newsletter.

Telephone calls are still arguably the best and most personal method for communicating with our clients. The problem with telephone calls is that they require a tremendous amount of staff time. I encourage you to create systems to utilize electronic communication whenever possible. Our clients are becoming increasingly more familiar and comfortable with communicating by email and text messaging. If we want to remain connected with our clients in the most efficient manner possible, email and text messaging is a viable option.

The duration between appointment and follow-up will vary based on the recommendation. Here are some examples of the follow-up communication we provide at Seaside Animal Care:
- All major medical appointments (vomiting, diarrhea, coughing, ocular injuries, etc.) – 24-hour email or telephone call depending on severity and at the doctor or staff’s discretion with a 48-hour telephone call for all clients not responding to email within 48-hours from visit

- All minor medical appointments (allergic dermatitis, ear infections, strain/sprain, etc.) – 24-hour email with a three-day telephone call for all clients not responding to email within three days from visit

- All surgery patients – 24-hour telephone call

- Weight Reduction – 30, 60 and 90-day emails with a telephone call reminder generated for clients not responding to emails

- Dentistry – based on the doctor’s recommendations, email reminders are generated at 7, 14, 30, 60 and 90-days with telephone call reminders generated for clients not responding to emails

- Senior Pets (over seven years of age) – targeted email newsletters twice a year

- Osteoarthritis – 30, 60, 90 and 180-day email reminders after a diagnosis of osteoarthritis is made. These reminders can also be linked to supplements such as glucosamine/chondroitin, omega-3 fatty acids and prescription NSAIDs

- Periodontal disease – (diagnostic code) targeted email newsletters sent twice a year

- Cardiac disease – after a cardiac evaluation, we send emails at 30, 60, 90 and 180-days with telephone call reminders generated for clients not responding to emails

- Bladder stones – after urolithotomy, we send emails at 30, 60, 90 and 180-days with telephone call reminders generated for clients not responding to emails

- Long-term medication monitoring – email and telephone call after initial visit and then every 90 and 180 days linked to blood testing

- New puppy and kittens – automatic emails after first visit with links to puppy and kitten information at our website

- New patients – welcome email with links to hospital information

These are simply suggestions and will vary from practice-to-practice. The key is to develop some sort of follow-up system for each of the targeted services you
wish to emphasize within your practice. Whether it’s through the telephone or the internet, the key is to reach out and touch your clients.

**Step 2 – Tracking your Progress**

To see if your message is getting through, you need to track your compliance. While there are innumerable tracking methods available, you should implement some means of measuring success. The first step is to evaluate how many times you performed the service or sold the product in the previous year. This is your starting point and can help you determine how much effort you should invest in the area. For example, even if you’re extremely passionate about hypoadrenocorticism or Addison’s disease, if you only diagnosed two patients last year, is it worthwhile to do target marketing to try and increase the awareness and testing for this condition? Focus on the common conditions and services such as **dental disease**, obesity, osteoarthritis, senior care and long-term medication monitoring. If you improve any one of these areas, you will see significant improvements in your clinic’s productivity and bottom line.

Emails are the simplest to use for tracking purposes. You will either have a client’s response (yes or no for tracking purposes) or they will fail to reply. If they do not reply, you can use telephone calls as a back-up. I recommend that you track a given service sector that you’re attempting to improve over a three-month period. In this manner, each quarter you can highlight a different offering helping avoid staleness and boredom. During the three-month period, you can use a written form that staff members record a client’s response to the service. For example, if you are emphasizing dentistry, you should write down each client you recommended a dental to and if they scheduled the appointment during that visit. If the answer is *no*, record any further correspondence on the list. In this manner you will have a good idea of your success with a given recommendation. This is a simple and highly effective tracking system for services that should be performed during that visit such as senior blood and urine tests. For areas such as osteoarthritis, you should track the number of supplements or NSAIDs you dispensed or prescribed or the number of services such as pelvic radiographs you performed.

Tracking compliance takes effort. It is an important part of the process but don’t let the act of measuring your compliance interfere with the act of making recommendations. If the tracking system is too burdensome, make sure your ability to conduct follow-up communications is simple and solid. In the end, you can use your practice management software to give you at least a general insight into how well you’re doing.
Step 3 – Review and Revision

Getting our clients to act upon our recommendations is an ever-changing process. New products, technologies and services come along each year that dramatically alter the way we practice medicine and interact with our clients. It is important that we not only keep up with the times but also with our message. At least once a quarter, you should review with your team your core messages: vaccinations, basic diagnostic testing protocols such as heartworm disease and intestinal parasite tests, senior care, weight reduction, osteoarthritis and periodontal disease to ensure that everyone is current with the latest information. Additionally, you need to appraise the information your team is sharing with clients. Role-playing is an excellent method to use when demonstrating the desired message and the manner you wish it presented.

Discharging a Pet that Needs a Dental Procedure

How we discharge a client impacts our compliance rates.

The client should always be escorted to the discharge area by the technician or assistant. Communication between the technician, assistant, and receptionist is critical at this point. This is the time to reinforce our recommendations, make sure the client leaves with all educational materials and medications, schedule the next visit, and show genuine concern and compassion for the client and pet. The client should never be left standing, unsure about what comes next. The following is a recommended sequence to making the experience joyful and making a HI-SCORE with your clients:

**Handoff** – The receptionist is ready and attentive to the client and technician exiting the exam room. The technician gives brief information about the pet’s conditions, behavior, prognosis and what additional products or information the client and pet need. Also informs the receptionist of follow-up appointments, next contact or expectations about laboratory results.

**Information/Products** – Technician and Receptionist get additional products or information for the client. The Receptionist never leaves the client unattended (i.e. dentifrice, toothbrush, diet, feeding guides, medications, products, additional educational handouts). Receptionist makes a compassionate statement about the pet and supports the need for service.

**Schedule Appointment** – Follow-up appointments are always scheduled prior to billing. Otherwise, you may forget and the client and pet will be ready to leave.

**Check charges** – Receptionist adds any additional items to the invoice and asks about the need for any other items such as heartworm preventative if it is an annual visit. Charges have been already entered by the technician/assistant
involved in the case so that charges are not missed. Remember never to discharge a pet without the record to avoid missed charges and failure to give client educational handouts.

**Invoice** – Review the charges without listing line items. It is important to maintain good posture and eye contact during the billing process. Reinforce salient points such as normal or negative test results, purpose of medications, expected course of treatment, recovery time, etc. When giving the invoice total, never say “dollars or cents”. Instead say, “Your total is one-twenty-six eighty.” This will help de-emphasize the “cold, hard cash” aspect of the transaction.

**Rechecks** – Always verify that the client departs with everything that she/he needs i.e. medications, discharge instructions, prescription diet, pet, etc.

**Exit/Enforce** – Receptionist gives a sincere goodbye and reinforces next contact between the client and hospital. “When will we see you again?” should be a question asked and answered verbally by each receptionist at every discharge. Opens the door and assists the client to the car if appropriate.

Dental care is much more than simply brushing a pet’s teeth. Seriously review your current protocols and create ways your team can promote better oral care for your patients. (And don’t forget to brush your own pet’s teeth!)
It’s More than a Smile: Why Dental Care Matters

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Why is dental care important to our patients and our practices? Really, who cares if a dog’s teeth are white or a cat’s breath is fresh? It is vital that we remind each client of the true impact of periodontal disease – from disease and illness, pain and discomfort and the interaction between owner and pet. Dental care is about so much more than the mouth – it’s about the entire relationship between veterinarian, person and pet.

Periodontal disease is the number one condition in all pets over three years of age according to the American Veterinary Dental Society. The AVDS reports that approximately 80 percent of dogs and 70 percent of cats show signs of oral disease by age three.

Periodontal disease refers to the condition in which bacteria attack the soft gum tissue and damage the underlying support structures of the teeth. Periodontal disease is the final stage in a process that begins with the development of plaque on a pet’s teeth. Plaque is a substance that forms when bacteria multiply on the teeth and gums. Plaque mixes with saliva and becomes the hardened substances known as tartar and calculus. Bacteria, plaque, tartar, and calculus irritate the gums, which become tender, red, and swollen. This stage of dental disease is called gingivitis. Eventually inflamed gums separate from the teeth, creating pockets that can trap more bacteria. These pockets deepen and bacteria may attack the roots of the teeth and the bony tissue of the jaw, causing teeth to loosen, the gums to bleed, mouth odor, and pain when your pet eats. This is periodontal disease.

Bacteria from the teeth and gums can enter the bloodstream and may travel to major organs and begin infection there. Among organs that are most often affected are the lungs, heart, kidneys, and liver. Parts of the nervous system may be affected as well. Although these infections are usually treatable when caught at an early stage, they can cause serious damage to these organs and, if not caught in time, may lead to death.

Key Client Communication Points

Oral infections contribute to:
• Heart valve infections – endocardiosis – this why the American Dental Association (ADA) requests that all patients with heart disease undergo prophylactic antibiotic treatment prior to any dental procedure
• Kidney infections – pyelonephritis
• Decreased immune function
• Bad breath
• Tartar/Gingivitis/Calculus
• Oral pain when tooth mobility develops or gum recession below the crown occurs

**Staging Periodontal Disease**

- Stage I - Initial gum disease and periodontitis - minimal plaque; reddened gums.
- Stage II - Early gum disease and periodontitis - greater plaque and calculus accumulation; swollen gums; some bleeding from the gums.
- Stage III - Established gum disease and periodontitis - moderate calculus accumulation; severely swollen gums; gingival pockets. Immediate danger of irreversible tooth damage.
- Stage IV - Advanced gum disease and periodontitis - large accumulation of dental deposits; gum recession; loose teeth; bone loss. Often involves mandatory tooth extraction(s).

**Consequences of Untreated Periodontal Disease**

- Severe gingivitis and bleeding from gums – Often painful
- Loss of appetite and ability to eat normal foods
- Halitosis or “bad breath”
- Tooth loss and broken teeth – Painful
- Tooth root abscesses and infections – Very Painful
- Heart valve infections – Endocardiosis
- Increased incidence of kidney and liver infections
- Nasal infections and increased nasal discharge and sneezing
- Loss of mandibular and maxillary bone resulting in physiologic fractures
- More severe infections when biting or chewing, including biting or chewing at skin (severe pyoderma)
- Reduced life expectancy due to poor diet and constant struggle with infection
- Diminished overall quality of life due to constant pain and discomfort

**Home Dental Care**
The gold standard for improving and maintaining proper oral health begins with daily brushing. The problem is simple: 1) who has time to brush their pet’s teeth every day or 2) is willing to do this or 3) has a compliant pet that will easily allow brushing? These real challenges don’t mean we shouldn’t recommend daily dental care; it means we shouldn’t chastise or clients if they fail to do so. During each second or third puppy or kitten appointment, we demonstrate how to brush their pet’s teeth and actively promote the practice. We stress the role oral health plays in longevity, quality of life and disease prevention.

I have a rule in my life that transcends into my practice: I don’t expect others to do more than I do myself. I’ve found than an honest, transparent approach to this issue yields better results. I readily admit to my clients that I don’t brush my pet’s teeth regularly. In fact, I brush my pet’s teeth rarely. As a result of my inability to brush my pet’s teeth regularly, I have their teeth cleaned every six to twelve months.

In addition to regular teeth cleanings, I also feed my pets a diet that has been demonstrated to reduce tartar and calculus buildup. I also use a water treatment to maintain fresh breath and promote good oral health.

In short, we encourage clients to perform whatever level of pet dental care they feel is practical for their lifestyle. We don’t admonish clients for failing to brush their pets teeth. The “pay me now or pay me later” philosophy is stressed explaining that their pets will require a dental cleaning and polishing every one to two years if they fail to provide regular teeth brushing.

Dental Scaling and Polishing

Dental prophylaxis is a term we commonly use to describe a dental scaling and polishing. To ensure maximum safety and to provide the highest level of care, we perform the following services with all of our dental prophys:

1. All pets receive a physical examination prior to anesthesia.
2. All patients have pre-surgical blood tests (complete blood cell count (CBC), chemistries and electrolytes) to ensure proper kidney and liver function, hydration status, and presence of infection. This helps us to evaluate a patient’s overall health status. Remember, we can not ‘see’ liver and kidney function on a physical examination.
3. All pets receive intravenous fluids by the use of an IV infusion pump. This aids in a faster recovery from anesthesia and provides an instant means for administering emergency drugs in a crisis.
4. We use only the safest anesthetics. Remember that there are no safe anesthetics – there are only safe anesthetists. However, we must always caution all clients that there always exists the possibility of an anesthetic complication, despite all precautions. We primarily use propofol injectable anesthetic. This is the same drug used on President George W. Bush when he underwent colonoscopy in 2002. In fact,
the risk of death is statistically lower than the chance of being killed in an automobile accident.

5. We monitor all patients with the latest in monitoring equipment. All patients are supervised by a staff member from the moment of induction until they are fully awake – they are never alone during the procedure. Pulse oximetry (SpO2), end-tidal CO2, ECG, body temperature, heart and respiration rates are continuously monitored on all patients undergoing anesthesia.

When to Talk About It

I typically begin the oral examination after examining the ears, eyes and nares. I ask the client to get out of their chair and come close to their pet to show them any problem areas. I want them to see and smell any periodontal disease present. If the teeth look great, I take this opportunity to congratulate them on their efforts. By actively engaging and interacting with clients, you’re more likely to impress upon them the seriousness of the condition. If a client remains distanced and uninvolved, it is much easier for them to ignore our recommendations for dentistry. It is imperative to make the connection between oral health and systemic diseases such as endocarditis. Too many clients view dentistry as merely a cosmetic procedure and see no value in keeping their dog’s teeth “Hollywood-white.” It is our professional obligation to make sure clients understand the relationship between the mouth and general health and well-being. If you note loose teeth, discuss pain. If you see gingivitis, remark about gum recession, tooth root exposure and the potential to adversely affect adjacent teeth. It is important to keep in mind that few clients thoroughly examine their pet’s oral cavity at home. Take this opportunity to lift the lip and educate your clients on the dangers of periodontal disease.

An important note: I recommend you point out and briefly touch on an abnormal finding during the course of the examination, regardless of the issue. I recommend you reserve the more detailed discussion for the time after your examination when you review pertinent findings with the client in a seated position. Additionally, you can also have a trained staff member give more detailed information on conditions such as periodontal disease after you exit the appointment.
Selling Veterinary Dentistry - Adding Value

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How can we increase our turnovers in a limited market? Many clients are already financially extended and veterinary dentistry is not cheap.

There are ways in which we can position ourselves in the market and add value to our service. Do we make use of the advertising potential of satisfied customers? Once you have given your client the cost estimate â€“ the next person to talk will loose. Learn the power of silence. Do not discount your services as this makes your loyal staff believe that what you and they do for your patients is not of value. Once you have pitched your price, donâ€™t drop your prices or your loyal clients will think you have been over charging them.

Communicate with your customer “if the procedure is going to cost more, call the client and inform them of the situation. Inevitably they will approve an increased cost estimate and happily pay when they collect their treasured pet.

Schedule routine follow-up examinations to determine success of the treatment and also routine annual examinations. Nurse clinics can be provided to help clients implement dental home care and determine how effectively this is being undertaken. Such a clinic may be provided at no additional cost to the client but will build practice good will.

Advertising to colleagues and clients can be undertaken depending upon the licensing authority.
Provision of tooth friendly diets, toys and treats will add to practice turnover.
Marketing Veterinary Dentistry

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Why marketing the dental department is important

1. Oral disease is by far the most common problem in veterinary medicine and there are generally only subtle to no clinical signs. However, patients afflicted with dental disease quite often have pain despite the lack of clinical signs. In addition, these disease processes cause significant localized and systemic medical problems. Ignorance abounds regarding dentistry both in the general public as well as in the veterinary field. This results in most patients being under treated. Therefore proper dental therapy is financially rewarding and good medicine.

2. There is nothing that will make a bigger difference in the health and attitude of your patients than a healthy mouth. By improving their pets’ demeanor, you will strengthen your relationship with the client.

3. Over the last decade or so, there has occurred a significant loss of traditional revenue streams due to many factors. Vaccine revenue has been markedly reduced by new studies. Flea medication and other prescription revenue has been lost due to online prescriptions. In addition, increased reliance on the internet or other information decreases the client trips to the clinic. Finally, the current world-wide recession has definitely influenced pet owners’ decisions about veterinary care.

How to Increase Dental Revenue

1. The first and most cost effective way to attain this goal is to increase the number of dental prophylaxis procedures performed. This can be accomplished through the following items:

   A. **Client Education:** This is best performed by enlightening your existing clients as well as the local population of pet owners about dental disease. This should be done by the veterinarian and the entire staff. This includes technicians, assistants and especially receptionists. The reception staff should be well versed in what a complete dental prophylaxis entails so as
to better communicate with the clients. Communication occurs via several methods, including:

i. In person
ii. Video Presentation with powerpoint in exam room
iii. Posters (www.vetdentalrad.com)

iv. Handouts/Brochures
   1. Local veterinary dentists
   2. Pharmaceutical/food/treat companies
   3. Dr. Visser/Niemiec

v. Websites
   1. www.dogbeachdentistry.com
   2. www.aidanimaldental.com
   3. Practice website

vi. Follow-up call on all cancellations
   (Sometimes more explanation can make all the difference)

vii. Reminder system for even routine prophies

B. Increase VALUE of service
   i. Call clients the night after the procedure
   ii. Give clients your home phone number

C. Increase referrals from veterinarians
   Monthly Newsletter (ideally via email)
   Provide seminars for veterinarians and their staff
   Volunteer at zoos or other animal organizations for exposure
   Serve on committees in local associations

D. Superior, new equipment: Once the marketing plan is underway and the days are full, superior equipment will speed procedures. A new drill, ultrasonic scaler, elevator, or curette can markedly cut down on surgical time and increase the number of procedures performed a day.
   i. Time is money
   ii. Less Anesthetic Time (better for patients)
   iii. If a practice can do one more procedure a day for 5 days each week at an average of say $400, it will pay off $8,000 worth of equipment in a month.
   iv. Cubex inventory control system(www.cubexsystem.com)

E. Equipment care and maintenance: Your equipment purchase should be properly cared for. This will have similar effects to purchasing new equipment.
i. Make sure technicians/assistants are properly maintaining the power equipment
ii. Hand instrument care and sharpening is critical but often poorly performed or not at all, resulting in less effective equipment and a decreased lifespan

F. Continuing education/training: By learning better techniques veterinarians and technicians can perform dental procedures more efficiently while providing superior service. This will benefit the patient, practice, and the staff.
   i. San Diego Veterinary Dental Training Center
   ii. American Veterinary Dental Forum
   iii. European Veterinary Dental College and Society CE seminars, labs and courses

2. The next way to increase income is by increasing the charge per dental procedure. This is best performed by increasing the number of available treatment options. This does not mean doing things like root canals, jaw fracture repair, and major oral surgery. At what most DVM’s charge for these services, it is not efficient time usage. By spending that time doing office calls the practitioner will increase income with less stress.

   The most efficient way to do this is to offer superior “basic” care. This should include:

   A. Dental radiology
      i. There is nothing that will provide the return on investment that dental radiology will.
         1. In addition, a professional radiology review from Vetdentalrad.com will greatly increase the number of procedures performed.
            a. Decreased “missed” pathology (Figure 1)
            b. Increased client compliance with recommendations

   B. Root planing/Doxirobe
   C. Oravet
   D. Regional Anesthesia (nerve blocks)
   E. Proper pain management (Opiates, NSAIDs, Milk)
   F. Fluoride therapy
   G. Bonded sealants
All of these will greatly increase income without a significant investment of time or money.

In addition, a slow increase in the level of fees is a easier way to increase fees. Instead of doing say 10% a year, do 1% a month.

3. Clinics can markedly improve their dental procedures and income by **improving their pre-operative testing protocol**.

   A. Complete blood panel (renal, hepatic, CBC, T4)
   
   B. Urinalysis
   
   C. Chest radiographs
      
      HCM is often not auscultated
      
      Over 50% of patients over 6yrs have significant findings on chest films.

4. Provide superior (and necessary!) **post-operative treatment**
   
   a. Pain management: Opiates, NSAIDS, Local Anesthetics
   
   b. Maxiguard, Oravet, homecare kits
   
   c. Free post-surgical rechecks
   
   d.

5. **Specific cases where income can be increased**
   
   A. Persistent deciduous teeth:
      
      These are a very common problem in small animal patients, especially toy breeds. In general, most clinics under charge and often under treat. These are large teeth that are time consuming extractions. By keeping the teeth, the clients can understand why the extraction is necessary as well as why it should carry a decent price. In addition, proper pain medication and radiology are critical for proper therapy.

   B. Fractured teeth with pulp exposure are a very common occurrence in veterinary medicine (approximately 10% of dogs have a broken tooth with pulp exposure). All teeth that are fractured with pulp exposure are painful and should be considered abscessed. Therefore, all teeth need to be treated via root canal therapy or extraction. This does “bother the dog” and therapy is critical. If a minor tooth, extraction is a viable option. If it is a major tooth and the client is to be referred for root canal therapy, the patient should be placed on pain medications and/or antibiotics and a minimum database performed.
C. Discolored (intrinsically stained) teeth. A study by Hale in 2001 reported that only 40% of discolored teeth have radiographic signs of endodontic disease. However, when physically examined, it was discovered that 93% of the teeth were in fact non-vital. Therefore all discolored teeth should be treated as dead and infected.

D. Feline tooth resorptive lesions are reported to be present in up to 60% of all cats greater than 6 years of age. These are VERY painful lesions and require therapy (extraction or crown amputation). These are often diagnosed with an explorer along the gingival margin. However, dental radiographs are critical for proper diagnosis and treatment of these lesions.
1. Full mouth dental radiographs are indicated when lesions are found as they will generally have additional lesions.
2. Full mouth radiographs are a good idea in any feline patient to rule out subgingival lesions
3. The decision of crown amputation vs. extraction can ONLY be made via dental radiology.

E: Oral masses are incredibly common in small animal dentistry (especially dogs). All growths no matter how small and normal appearing should be sampled and submitted to the lab for histopathologic analysis. In my experience about 1% of these biopsies will turn out to be malignant and need additional therapy. In addition they should all be radiographed to evaluate for bony involvement. This will help the pathologist to determine level of aggressiveness.

F. Uncomplicated Crown Fractures are a very common finding in large breed dogs (at least 50%). This occurs when a piece of the crown is broken off, without pulp exposure. Occasionally, these teeth can become infected through the dentinal tubules and will go undiagnosed without dental radiology. However, teeth with no to small pulpal exposures tend to be the ones with clinical abscessation. Even if these are not infected, they are at least transiently sensitive and require restoration.

G. Periodontal disease is the number one diagnosed problem in small animal patients today. By the age of 2 yrs: 70% of cats and 80% of dogs have some degree of periodontal disease. This incidence increases with age. This has both local and systemic problems associated with it. By stressing these issues, the practitioner will greatly increase compliance with recommendations.
1. Severe local effects include: oronasal fistula, class II perio-endo abscess, pathologic fracture, osteomyelitis, and ocular problems.
2. Severe systemic effects include: renal disease, cardiovascular disease, hepatic disease, Chronic Obstructive Pulmonary Disease, diabetes mellitus, adverse birth
effects, osteoporosis, thromboembolic disease.

3. In short, it is a state of chronic disease which the patient needs to deal with on a daily basis.

The majority of dental patients will have periodontal pockets greater than 3mm. These pockets are pathogenic and need to be treated to control periodontal disease. This will not only increase the oral and overall health of the patient, but also the practice income. These teeth should all be radiographed to rule out endodontic involvement and under diagnosed periodontal loss. If more than one or two teeth are involved, full mouth dental radiographs should be considered. Following this, all pockets between 3 and 6 mm are best treated with root planing and instillation of a sustained release doxycycline product.

Periodontal pockets greater than 5-6 mm or which have furcational involvement or other issues CANNOT be effectively cleaned without direct visualization of the root surface. These areas require periodontal surgery for proper therapy. Periodontal surgery is very effective in animal patients and should be offered to clients, especially in cases of strategic teeth. Additionally, periodontal surgery is not a difficult skill to learn and does not require a significant financial investment.


**H. Extractions:** Extractions are a surgical procedure and should be charged for as such. I prefer an hourly rate instead of an individual tooth extraction rate. By calling it oral surgery, it changes client perception of the procedure. Dental radiographs should be exposed preoperatively to document the need for extraction as well as any possible complications such as:

1. Weakened bone
2. Curved, ankylosed, or extra roots

In addition, dental radiographs should be exposed post-operative to ensure complete extraction.

1. Good medicine
2. Unrelated issues

Finally, pain management including local anesthetics should be administered.
CONCLUSIONS

➢ Dogs
  ➢ 80% have periodontal disease
  ➢ 10% have fractured teeth with pulp exposure
  ➢ 25% (conservative) have uncomplicated crown fracture
  ➢ 5% have other dental problems (neoplasia, orthodontic problems, cares, etc)

➢ Cats
  ➢ 70% have periodontal disease
  ➢ 40% have FORLs
  ➢ 10% have other problems (including fractures)

100% of veterinary patients have some type of dental disease!

There is no other area of veterinary medicine that has the potential that veterinary dentistry does. Just by doing proper and thorough dental work (do the basics well) practitioners can greatly increase the overall health of their patients as well as dental income.
Equine session
The equine skull has evolved to adapt to the specific demands of a large, herbivorous ungulate: the combination of the animal’s large dimensions and diet have implied an ability to process large amounts of fibrous and silicate rich, poorly energetic feed. Therefore the oral cavity is designed to grind tough plant materials in large amounts and on a nearly constant basis. There is little doubt that the constraints of domestications have largely altered this pattern of behaviour but the understanding of the underlying physiology is paramount to better approach the pathophysiology of dental disorders. Because of the large dimensions of equine teeth, there is a close relationship between the oral and nasal cavities so the entire face should be regarded as a single, intricate functional unit.

1. The oral cavity
The oral cavity comprises the space between the prehensile mouth (lips) and the pharynx and it is the first part of the digestive tract, where food must be processed to pass through the oesophagus and into the stomach. If its basic design is similar to that of other mammals, specific adaptations should be considered: The oral cavity is long but narrow, probably to optimize the grinding surface in relation to the volume of food stuff. The cheeks are tight and muscley all the way to the incisor bones and allow the horse to bring back the food towards the grinding surface of the tooth tables. This explains in part why tooth points and ridges can cause severe damage to the mucosa on the oral surface of the cheeks. The tongue is thick and powerful and mostly fills up the potential space between the tooth arcades and the palate. The caudal part of the tongue is tightly applied against the ventral surface of the soft palate. The latter is long and wide, thus forming a tight valve and precluding foodstuff from passing in a retrograde manner back into the mouth. Clinically, a major consequence is the inability of horses to breathe or regurgitate through the mouth.

2. The nasal passages
The equine nasal cavity is long and voluminous, designed to filter, warm up and hydrate the large volumes of air required to meet the extraordinary oxygen demands of a 500 kg animal running at full speed. The four conchae (or ‘turbinates’) fill up most the nasal passages, providing by their intricate network of thin mucosa covered bone an immense surface of contact with air. The largest passageway is the ventral meatus, located ventromedial to each ventral conchus and lateral to the nasal septum. The dorsal meatus is narrow and curves caudally with a dorsal convexity, passing ventrolateral to the ethmoid turbinates. The middle meatus is located between the septum and the two conchae on each side of the nasal cavity. Each meatus measures less than 4 or 5cm in diameter. Caudally, the conchae become smooth and form the medial wall of the paranasal sinuses. The dorsal nasal conchae blend into the ethmoid conchae and small middle conchal recesses.

3. Paranasal sinuses
These large skull cavities are probably designed to increase support and protection to the head while keeping it very light. They may also play a role in the thermoregulation of the cranium. They are bound by the conchae medially and the maxillary bone laterally and lined by thick respiratory mucosa. There are several schools of classifications. The simplest divides the sinuses into frontal, maxillary and sphenopalatine. The latter, located within the sphenoid bone at the base of the cranium, is small in horses. The sphenoid part is caudal, the palatine part lies ventral to the ethmoid and communicates through the palatomaxillary opening with the caudal part of the ventral conchal sinus.
The frontal sinus is subdivided into frontal sinus dorsocaudally and dorsal conchal sinus rostrally, the latter being the sinus extension into the dorsal conchus. It drains ventromedially through a large, oval opening (the frontomaxillary opening) into the caudal maxillary sinus. The opening is bound medially by the ethmoid, which protrudes into the frontal and maxillary sinuses, and laterally by the medial wall of the orbit, which contains the osseous part of the lacrymal duct.

The maxillary sinus is divided into caudal and rostral compartments, by a complete, septum, usually set over M1 or at the rostral root of M2. It runs obliquely in a dorsocaudal direction and in a frontal plane. Finally, the caudal part of the maxillary sinus is further subdivided parasagittaly by the infra-orbital canal into a larger lateral compartment (caudal maxillary sinus) and a narrow medial compartment, the ventral conchal sinus. The latter is located within the caudal part of the ventral conchus and communicates caudally with the sphenopalatine sinus. The rostral and caudal maxillary sinuses both open into the caudal dorsal part of the middle meatus, through thin, oblique slits that merge more or less.

There is a very close relationship between the paranasal sinuses and caudal cheek teeth in horses, the roots and part or the reserve crowns protruding largely into the maxillary sinus cavities, only separated from them by thin alveolar bone and mucosa. However, this arrangement changes throughout the animal’s life. In foals, the crowns and roots completely fill up the sinus spaces. As the teeth erupt and the reserve crowns shorten, the roots move distally, freeing up more and more air-space. In older horses, the roots eventually reach the ventral boundary of the sinus, the space between the root and sinus cavity filling up with bone. This arrangement varies not only with age but also between individuals of similar age. The caudal maxillary sinus usually contains the roots of the last two cheek teeth (2\textsuperscript{nd} and 3\textsuperscript{rd} maxillary molar teeth). The rostral compartment varies in size and location, so that it may relate only to all or part of the 1\textsuperscript{st} molar tooth or sometimes also contain part or most of the last premolar. With growth, the teeth move rostrally in relation to the sinuses.

The complex 3D arrangement of the nasal and paranasal cavities is often difficult to comprehend and impairs adequate evaluation through conventional radiography, so that only cross-sectional imaging techniques (esp. computerized tomography) will permit thorough examination. The small size and recessed location of the maxillary openings also precludes from using a non-invasive trans-nasal endoscopic approach to the sinuses, so that trephination is a pre-requisite to sinusoscopy.
4. Equine teeth

As in most mammals horses have two sets of teeth, decidual and permanent. The **deciduous formula** is $I_3/C_0/P_3$. The **permanent formula** is $I_3/C_1/P_4/M_3$ with some variations. Equine teeth are hypsodont; they erupt continuously to compensate for the wearing of their table (masticatory surface), giving them a specific structure and specific pathology.

Equine teeth are long and cylindrical. The bulk of the tooth is made of a cylinder of **dentine**, a bone-like tissue without haversian structures. In the centre of the tooth, the **pulp cavity** contains nerves and vessels. The dentine being prone to erosion, it is further protected at its periphery by a layer of **enamel**, a very hard mineralized tissue, and then a final layer of **cement**, which forms the smooth surface seen. Typically in horses, this 3-layer ‘wall’ folds in at the tip of the crown, so that in cross section the crown is composed of 6 concentric layers (from periphery to center: cement – enamel – dentine – dentine – enamel – cement. This infolding of the crown creates a very thin, central cavity, the **infundibulum** (‘cup’), which fills with cement and debris.

The teeth are attached to the alveolar bone through a specialized periosteum, rich in type I collagen and vessels. It is often termed **periodontium** or **periodontal ligament** and creates a strong link, so that alveolar fracture is a major risk when attempting to extract teeth.

**a. Incisor teeth**

**Deciduous incisors** are short with a small, distinct crown, the root is short. These teeth, once erupted, keep erupting until the pressure of the underlying permanent incisors cause resorption of the root, so that eventually only a ‘cap’ of vestigial crown remains.

**Permanent incisors** are more even in structure, there is no visible neck between the crown and root. The infundibulum is deep. The pulp cavity, though very narrow, extends far distally into the dentine bulk so that it overlaps partly with the infundibulum, forming as the tooth wears down at the crown a second cavity or ‘star’, rostral to the cup. The latter eventually disappears while the star increases in diameter. The variation of the tooth shape and table with age are the main basis to ageing that will not be addressed here.

**b. Canine teeth (‘tusks’)***

In theory, only males (or geldings) have 2 sets of canines. However, a small proportion of males will be devoid of erupted canines, while approximately 25% of females have mandibular canine teeth, usually very small or vestigial. A small proportion of females (less than 10%) have only upper or both lower and upper canines.

The canines do not participate in grinding and as a result do not grow once erupted, although they will wear down to some extent. They present a conical, lateromedially flattened crown and a round root, the upper canines are more caudally placed at the junction between the premaxilla and maxilla.
c. Cheek teeth

This term is used to describe the **premolar and molar** teeth as their structure is indistinguishable in Equids. There are normally 6 such teeth on each arcade (3 premolars from PM2 to PM4 and 3 molars from M1 to M3). There is commonly a vestigial first premolar on the maxilllas (‘**wolf tooth’**), which erupts around 6-12 months or sometimes remains under the gumline. Some horses also have a mandibular PM1. Most wolf teeth are shed with the 2<sup>nd</sup> deciduous premolar but they may persist in the adult. It should finally be noted that a small proportion of horses have a 4th set of fully developed molars.

The basic structure of cheek teeth is similar to that of the incisors, but they are more complex due to the presence of two infundibula and several recesses to the pulp cavity (5 in the maxillary teeth, 2 in the mandibular teeth).

The **maxillary cheek teeth** are well embedded into the alveolar process of the maxilla, a large part of the reserve crown and root protruding into the sinus cavity all the way to the infra-orbital canal in young adults. They are covered at that level by a very thin layer of bone. As the tooth erupts, there is some continuous deposition of dentine so that the root ‘closes down’ progressively and the tooth can persist for some time before being totally expelled in older horses. The maxillary cheek teeth are square in cross section with the two infoldings of enamel giving the table a B shape with the buccal surface being flat with a central, vertical ridge and the lingual surface being more convex. The latter also presents with a secondary infolding of enamel, forming a vertical ‘**accessory pillar**’ along the crown. The first and last cheek teeth are triangular in shape. All the teeth are normally in tight apposition at their contact surface, thus preventing accumulation of food between the teeth.

The **mandibular teeth** are narrower in a lateromedial direction. The infundibula open medially on the lingual surface of the tooth, but they are filled with cement. Complex folds of enamel give the table an E-shape, with the branches of the E towards the lingual surface.

This complex arrangement allows the tooth surfaces to form a tough grinding table with sharp enamel ridges separated by shallow cavities. This will shred and crush the grass material before it is swallowed.

Finally the arcades are not flat. Horses masticate in a complex bell-curve movement from side to side, so that the upper arcade is much wider than the lower arcade and the tables are angled from dorsomedial to ventrolateral. Even wear of the tables implies symmetrical lateral movements of the jaws and there is a natural predisposition to the occurrence of sharp ridges at the distolateral edge of the maxillary cheek teeth and medial ridges on the mandibular teeth.
Diastemata: Definition, Aetiology, Diagnosis And Treatment Options In Horses

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According to Collins and Dixon, 2005 equine cheek teeth diastemata is an under diagnosed condition due to inefficient examination of the cheek teeth.

A diastema is defined as an abnormal space between adjacent teeth â€“ the pleural is diastemata. In horses two types of diastemata are described: diastema and valve diastema. The latter differs from the former in that the occlusal contact still exists but contact is lost where the crown tapers in a gingival direction. Food particles are forced through the contact point and accumulate between the teeth and in some cases is forced into the periodontal space causing severe periodontitis. Congenital diastemata result from tooth buds that develop too far apart and also lack of angulation of the distal and proximal cheek teeth limiting formation of the cheek tooth battery. Acquired diastemata result from tooth movement that may be secondary to cheek tooth extraction or malalignment. Ramps or hooks may cause the affected tooth to be moved forming a diastema. Exaggerated transverse ridges can force food particles into interproximal spaces forcing the teeth apart.

Open-mouth oblique radiographic views can be used to evaluate the cheek tooth battery for diastemata. It is very important that a lateral-lateral projection is obtained to correctly view the interproximal areas.

Two treatment approaches have been described: opening the diastema and obliterating the diastema. In the former a bur is used to remove tooth substance to enable food particles to pass into and out of the diastema without impacting. In the latter dental acrylic or silicone is placed in the cleared diastema to prevent food from being impacted into the diastema. Ancillary treatments will be required in addition, including: feeding finely milled hay, removing ramps/hooks, reduction of exaggerated transverse ridges and extraction.
Oral Examination And Charting In The Horse

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Charting is an essential part of the clinical record and can be incorporated in the horse's passport. A systematic approach to oral examination should be developed by the veterinary surgeon. Without sedation and the necessary equipment a thorough oral examination is nigh impossible.

Requirements include: oral (full-mouth) speculum, chin rest, light source, dental explorer and probes, oral mirror, dental recording chart and a good sense of smell. A rubber wedge gag may also be necessary.

The teeth cheek teeth function as a unit known as the cheek tooth battery. Proximal teeth are inclined rostrally while distal teeth are inclined caudally maintaining interproximal contact. Incisors also have occlusal contact until the horse becomes aged and then occlusal contact may be lost as the narrower part of the crown comes into occlusion. In males the canines are present from about 4 years of age and the mandibular canine is positioned distal to the maxillary canine. There is an edentulous space (inter-alveolar space) between the canines and the premolars; these spaces on the mandible are known as the bars of the mouth and accommodate the bit.

Occlusion should be examined with the head held in a normal position. If the neck is extended in an upward manner the mandible is drawn caudally and the maxillary incisors will overjet. Spaces between the incisors or cheek teeth will accumulate food and form diastemata that may lead to periodontal disease. Trapped forage should be picked out to enable examination of the interproximal space and the periodontium. Circumferential probing of the periodontium should be performed with a probe of known dimensions.

Lateral excursion of the mandible should be performed to determine at which point incisor separation occurs. The sooner separation occurs the more shear the cheek teeth will be. With a flatter cheek tooth occlusal surface, separation will occur at a greater distance from the I1 divide. The shape of the cheek teeth and incisors and their alignment should be recorded showing, hooks, ramps, steps, waves, shear mouth etc. The occlusal surfaces of teeth should be examined for caries, sharp enamel points and fractures.

Presence of caps, mixed dentition, persistent deciduous teeth and ßwolf teeth should also be recorded. Palpate teeth that appear to be mobile. Malodour may be isolated to a specific point by palpation.
Observe the mandible, maxillae and masticatory muscles for symmetry, swellings and sinus tracts.
Periodontal Disease In The Horse, A Review

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Periodontal disease is widely recognized and well described in humans and small animals. As in other species, periodontal disease in horses represents a source of oral pathology and pain. Significant anatomic and functional differences exist between hypsodont and brachydont teeth. This review will present the current information available relating to periodontal disease in the horse, and will discuss both similarities and differences in periodontal disease in this hypsodont species.
Associations of certain dental malocclusions with age group and gender of horses

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Aims: To examine the prevalence and types of malocclusions present in a general equine population, and investigate potential associations between certain malocclusions and the age group and gender of affected horses.

Methods: Data from 100 dental charts (1999-2006) were reviewed and analysed.

Results: Horses had a median age 12 years, included 69% geldings and 31% mares and 52% had cheek teeth (CT) and/or incisor malocclusions. Incisor malocclusions affected 35%, including overbite (8% prevalence), ventral curvature of occlusal surface (21%), and irregular occlusal surface (6%). Cheek teeth (CT) malocclusions affected 42% and included focal overgrowths (19%), sloping overgrowths (15%), tall CT (16%) and wavemouth (6%). Using chi-square tests, statistical associations (p<0.05) were demonstrated between; the 6-10 year age group and overbite and focal CT overgrowths; 11-15 year age group and any incisor malocclusion; 16-20 year age group and irregular incisor occlusal surfaces, any incisor malocclusion and focal CT overgrowths; 21-25 year age group and any incisor malocclusion and wavemouth; 26-30 year age group and ventral incisor curvature, sloping CT overgrowths and tall CT. Dependence were also demonstrated between gender and any malocclusions, any incisor malocclusions and ventral incisor curvature.

Conclusions and Practical Significance: The prevalence and type of incisor and CT malocclusions recorded differed from those of referral populations. An association was found between certain types of malocclusion and age group which highlights the need for targeted dental treatment in different age groups. The association of gender with certain malocclusions may have been affected by the predominantly neutered male population examined.

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The treatment of overjet / overbite in the horse

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Orthodontia is a specialization within dentistry that focuses on the optimization of the position of the teeth within the arcades in order to optimize occlusion of the teeth. In equids compared to humans and small animals this discipline is not very well developed. However, every general and routine floating of the teeth could fall under this definition as it is aimed at correcting malocclusions in order to prevent others.

In horses, congenital dental disorders that lead to malocclusions are not uncommon. Brachynatatio inferior or a shortened mandible is reported as the most common congenital dental disorder in the foal (Knottenbelt and Pascoe 1999). Another type of deviation is proganthia, that can be presented in the upper or lower jaw but typically is found in small pony breeds in the lower jaw and termed monkey mouth. Without any form of approved measures, the use of brachynatia or prognatia is difficult to apply as one is not able to identify the shortened from the elongated jaw. Therefore, the use of the terms overjet and overbite are more easily apply able.

Overjet is defined as the horizontal projection of the maxilla compared to the mandible, the overbite is defined as the vertical projection of the maxilla compared to the mandible (Ferraro 1997) and can only be present after a certain degree of overjet. Once overbite has occurred, the treatment of the disorder will be more difficult as not only an elongation of the mandible but also a dorsal inclination of the pre-maxilla will have to be obtained.

Even if foals can be born totally normal, overjet can appear in the first weeks or months of live as illustrated in the only retrospective study on brachynathia available to date (Gift, Debowes et al. 1992). In this review, half of affected foals were normal at birth and developed overjet in the first three to six months of live. Possibly, crossing of breeds with different head morphology can predispose to the development of the condition and relationship with developmental orthopedic diseases has been postulated. On the other hand as occurs in human medicine, trauma to the developing temporomandibular joint structures could be the initiating factor for those animals developing the condition in the first few months of live (Shafer, Hine et al. 1983). However this has never been reported or investigated in the horse.

As the mandible presents some degree of rostro-caudal mobility compared to the maxilla, the degree of occlusion can vary with the position of the head. Maximal occlusion will be present when the horse is grazing, with the mandible most rostrally and upper and lower incisives in occlusion. When the horse raises the head, the mandible is pulled caudal and a variation in occlusion from 3 to 9 mm can occur according to a study performed by Carmalt et al. (2003).
Therefore evaluation of the degree of overjet should be performed systematically with the horses head in a lower position.

Conservative treatment

In mild cases and considering the potential genetic basis of the disorder, possibly no treatment should be initiated.

If treatment is initiated, the growth potential of the animal should be used at its maximum to correct the disorder. Therefore, first of all every origin of dental interlock should be removed (Klugh 2004). And in foals with one or two mm of overjet rasping of the occlusal surfaces of the molars to remove transversal ridging and rostral and caudal hooks creating interlock will help in ease rostro-caudal movement of the jaws and is often sufficient to correct overjet.

In more pronounced cases and in cases presenting not only overjet but also overbite, the placement of a biteplate on the upper incisive arcade will ease the sliding of both jaws and push the pre-maxilla dorsally (Klugh 2004) in order to correct/prevent overbite.

Surgical treatment

Surgical correction using cerclage wire and biteplate is the treatment of choice in foals that still have growth potential left. The principal of the treatment is to obtain a growth retardation at the level of the maxilla in order for the mandible to catch up with the maxilla. The maxillary incisivel corpus is fixed with cercalge to the second or third maxillary premolar. The brace is optimally placed when the foal is about three months of age and left in place till full correction is obtained. About 5 mm correction can be obtained in this way every 3 to 6 months(Easley 2005). The exact application technique has been fully described (Easley 2005; Dixon and Gerard 2006; Verwilghen 2008; Verwilghen and Vlaminck 2010)

In some cases even after successful treatment the condition has been described to reoccur. It is therefore important not to heavily feed the animals after treatment has ended as a growth spurt after introduction of concentrate feeding was reported as a reason for failure of the therapy (Verwilghen and Vlaminck 2010).

In older horses where the benefit of natural growth can not be obtained, other surgical corrective techniques should be considered. Osteodistraction as a corrective technique for mandibular shortness in humans was first described in dogs in 1973 (Snyder, Levine et al.) and is widely used nowadays.

Distraction osteogenesis is governed by the principles of tension-stress were the tissues subjected to gradual, slow, and steady traction become metabolically active, stimulating proliferative and biosynthetic cellular functions and combining controlled osseous healing with remodeling of bone and soft tissues. Specific latency time (time between osteotomy and initiation of the distraction), distraction rate (mm/day of bone stretching), rhythm (number of distractions/day) and consolidation period (neutral fixation) are not available for use in horses. However the technique is applicable as was shown in a report by this author (Verwilghen, Van Galen et al. 2008).
In horses where the overjet has not been corrected, overgrowths (ramps and hooks) of the 06 and 11 occur leading to different dental and gastro-intestinal pathologies. Frequent dental investigation and floating is therefore mandatory in these patients.

Take home message

Overjet is the most common dental congenital disorder of the foal and can be corrected with little invasive orthodontic techniques early in life. Once the benefit of natural growth is exceeded more invasive techniques as osteodistraction can be applied.


Myths and misconceptions in equine dentistry

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Equine dentistry is one of the most common tasks performed by large animal practitioners. One study dated 1994 by Kirkland showed a prevalence of dental disorders in equine cadaver skulls as high as 80%. In general practice, however, much dental disease is overlooked because of lack of thorough oral examination. Dental care in horses remain behind that of dogs and cats and this can be due to several factors: because there is a lack of formal education in equine dentistry, because dental techniques routinely used in brachiodont patients cannot be applied to horse’s dentition, because some traditional practices and misconceptions are still being taught and shared. Equine dental publications exist from circa 600 BC. Despite this incredible history, equine dentistry sadly remains an art and not a science (Carmalt 2007). The benefits of interventional dentistry (ie, oral extraction or repulsion in cases of diseased teeth) are obvious and do not need randomized trials, but the importance of common dental procedures like dental floating, bite sits, wolf teeth extraction, incisors and canines reduction has not been fully validated. It has also been stated that horses focus on the pain rather than on performance when experiencing oral discomfort but the research behind these statements is not available.

As further research is conducted, many things that were once considered fact are disproved, yet reevaluation of beliefs does not always keep pace with the rate of scientific discovery. Beliefs that are not evidence-based fall into the realm of myth or misconception.

**Myth**- Routine dentistry (floating) can be carried out without sedation and without the use of a full mouth speculum.

**Reality**- dental abnormalities will be missed if a full-mouth speculum is not used to perform the oral examination. A complete oro-dental examination cannot be accomplished without sedation, the use of a full mouth speculum, a bright light source, dental explorers/probes and an intraoral mirror.

**Myth**- Sharp enamel points are mainly due to domestication of the horse.

**Reality**- We do not know if sharp enamel edges are actually a dental disorder, but alternatively are a normal feature of Equidae cheek teeth.

**Myth**- Routine floating is a procedure that can prevent oral lesions in ridden horses.
**Reality** - The current, standardized prophylactic dentistry is not effective in preventing oral ulceration in ridden horses.

**Myth** - Routine floating improve performance in sport horses

**Reality** - Routine floating is not clinically correlated with mastication or work performance.

**Myth** - Wolf teeth were blamed for eye problems, including inflammations and blindness.

The term eye tooth was also used as a synonym of wolf tooth

The presence of wolf teeth is blamed for many behavioural problems and for interfering with the bit. Wolf teeth should be always extracted. This procedure is quick and easy.

**Reality** - Wolf teeth extraction is NOT necessarily an innocuous procedure. Wolf teeth that are enlarged, displaced, loose, fractured or diseased and any mandibular 05s can be considered to be a source of pain. The extraction of these teeth is indicated. Myth:

**Myth** - Generalized incisor overgrowths cause the CT to be held apart and prevent proper mastication.

**Reality** - Only rarely will incisor abnormalities (even major) lead to difficulties in prehension.

**Myth** - Routine dentistry involves minor procedures.

**Reality** - The vast majority of equine oral procedures are dental-related and, unless great care is taken, almost all such procedures can make short or long term damage to oral structures.

Thermal trauma is a major concern with the use of motorized instruments.

Pulp exposure must be considered when reducing overgrowth.

The layer of occlusal secondary dentin overlying the pulp chamber can be as thin as 3 mm, even in adult horses.

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A long-term study of apicoectomy and endodontic treatment of apically infected cheek teeth in 12 horses.

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The aim of this study was to evaluate the long-term results of apicoectomy and retrograde endodontic treatment in 12 horses with apical cheek teeth infections. The affected apices were removed using a diamond bur mounted on a dental drill, and after pulp removal the root canals were filed with Hedstrøm files and then alternately flushed with sodium hypochlorite, hydrogen peroxide and alcohol. The pulp canals were dried and filled with endodontic cement and gutta-percha points. An undercut was made in the apical aspect of the root canals that were then sealed with self-curing glass ionomer cement. Follow up information was obtained 38-67 months following treatment and indicated that the treatment had been successful in 7/12 horses (58%), partially successful in 2 horses (17%) and unsuccessful in 3 (25%). With good case selection, apicoectomy can preserve a proportion of apically infected cheek teeth. The use of advanced imaging techniques and improved surgical techniques could increase the success rate.
Applying Advanced Record Techniques For Dental Charting In The Study Of Oral And Dental Pathology In Endangered Breeds Of Donkeys, In Field Conditions.

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Introduction
Collecting and saving clinical data obtained during a complete oral and dental exam (in field conditions) in a simple, fast and effective way can be extremely complicated, even if that should be a primary concern of any vet. Such data would usually be captured on paper forms and would then be transferred to a PC back at the office, which often implies the loss of information or the incorrect data entry in the database. This study presents a new electronic application, using Cyber Tracker free software (www.cybertracker.co.za), developed with the aim of capturing and storing information in systematic and organized way, while performing field work in equine dentistry. This scientific data collection electronic application, mainly based on a multiple choice screen touch digital questionnaire, decreases the likelihood of human error when entering data in the database. The described application was first developed to be used in an epidemiological research in oral and dental disease in two endangered breeds of donkeys: The Mirandês from the Northeast of Portugal and the Zamorano-Leonês Donkey, from the Northwest of Spain.

Method
In the close regions of the Northeast of Portugal and the Zamora Provence in Spain, two different native breeds of donkeys are still working and co-existing with the local population: The Mirandês Donkey from Portugal and the Zamorano-Leons Donkeys from Spain. These two breeds are nowadays threatened of extinction, with only a few hundreds of these animals still breeding, as a result of the disappearing of the traditional rural activities in these very rural regions. The low number of animals results in a high level of inbreeding between them, the loss of genetic variability and the appearance of pathological situations, some of them teeth related.
Donkeys are very stoic animals, with a high number of animals suffering from undiagnosed dental and oral diseases, with most of them not revealing any clinical sign of it. A similar situation can also be observed in horses, although these are less stoic. An epidemiological comparative research of the oral and dental pathology in these two breeds is being carried out, thinking on welfare and genetic preservation issues, with relevant results found until now.
The first step was drawn up a complete list with the important information necessary for this research before, during and after the complete dental and oral clinical exam. The information present in the aëcêlive survey clinical and oral chart includes: Owner details, Animal details, Clinical records, Diet details, Clinical exam (Physical examination), Oral examination (soft
tissues, occlusion, different teeth groups pathology, other pathology, among others), Sedation procedure and Treatment. The same topics were used in the electronic application.

The electronic application is based on a sequence of different screens, with the main related dental charting question in each one of the screens, together with the possible different answer(s). The Cyber Tracker application is customized to answer our data collection needs. The screens can appear as a radio list (for a single answer option, like gender) or a check list (for multiple answers), but also number and text fields can also be added by means of conventional key pads or keyboards. The electronic application is running only in a PDA (Personal Digital Assistants) system device or a Smartphone with screen touch properties, both requiring the Microsoft Windows Mobile® or PalmOS software® installed to run the application, becoming an efficient and fast way to gather large quantities of data1.

Results
The described electronic working tools is a new, complete and easy to use application developed for a PDA device system, allowing recollecting data in field conditions. All the useful information obtained during the clinical and oral exam is kept in the PDA device memory, until the moment it is connected and synchronized with a computer, being all the data then downloaded. Data can be viewed in tables in the computer that will be automatically updated when new data is collected and downloaded. In these tables, the information can be filtered, depending on the specific information to be obtained and it can be exported to different format (e.g. Microsoft Excel®), and then sent to statistic software programs.

Discussion
Developing technology that facilitates the ability to collect and store clinical data is of crucial importance, mainly in epidemiological terms. This new kind of working tools is of particular importance when applied to studies carried out almost exclusively under field conditions, with such a high number of animals (around 350 to 400 donkeys from each one of the breeds) and with a big geographical area. With this new method it is possible to increase the capacity to gather data both quantitatively and qualitatively, allowing the researchers to gather much more data than with paper-based systems.

Conclusion
Applying this PDA-based scientific data collection application technology to equine dentistry area, we were able to develop an attractive and advantageous working method in field conditions.

It is important to remark that the electronic application developed for this research is also available for the clinicians inside an equine hospital, with enormous benefits for the hospital data management procedures. All the information inside this application can be easily changed, answering different needs.
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Case control study to identify a possible relationship between dental pathology, impaction colic and faecal particle size distribution in horses: preliminary results

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Introduction

Although the frequency of dental care does not seem to positively affect the occurrence of colic (Cohen et al., 1995; Hillyer et al., 2002), dental pathology is commonly believed to be a contributing factor to (impaction) colic in horses (Mair et al., 2002; White et al., 2008). Studies in donkeys have shown that dental disease, especially the presence of diastemata is significantly associated with colic in aged donkeys (Cox et al., 2007; Du Toit et al., 2008). Yet still unproven, inefficient mastication due to painful or biomechanically hindering tooth pathology might decrease feed digestibility which could result in higher susceptibility to development of impaction colic and a higher content of long fibres in the faeces. The purpose of this study was to evaluate possible associations between dental health and faecal particle size comparing horses suffering from impaction colic and control horses. It was hypothesized that mean particle length in faeces of horses suffering from impaction colic would be higher compared to control horses and that a higher proportion of long fibres would be found. It was further hypothesized that dental pathology scores would be higher in impaction colic cases and that this score would be positively associated with faecal particle distribution and mean faecal particle length.

Materials and Method

Cases were horses presented with colic attributable to large colon impaction. Diagnosis was based on clinical examination (including rectal examination, nasogastric intubation and if indicated abdominal paracentesis), abdominal ultrasonography and laparotomy, the latter only when indicated. Control horses were randomly chosen from patients presented to the clinic for diverse reasons. Controls were excluded from the study if their diagnosed pathology had an important impact on their general physical health and eating behaviour. Also patients with a history of colic or tooth related problems in the last year were excluded from this group.

After proper sedation and using a full mouth speculum, bright light source and dental mirror, the dentition of all animals was carefully examined. Any pathology was recorded in writing and drawing on custom-made dental record sheets. A pathology score was calculated...
incorporating four categories including soft tissue lesions, periodontal disease, cheek teeth occlusion and cheek teeth arcade wear patterns. For each category a score between 0 and 2 was assigned based on the severity of the encountered pathology. Scores from the 4 categories were added to a total dental pathology score ranging between 0 and 8.

Faecal samples of all animals were collected for a standardised particle sieve analysis using a wet sieve technique (Uden and Van Soest, 1982). Six sieves with respective mesh size (diagonal pore sizes) of 4.75; 3.35; 2.36; 1.18; 0.60 and 0.30 mm) were used. Before analysis, they were dried in an oven at 65° and each sieve was weighed. A subsample of 50 g fresh faeces was soaked for 15 min in 1 l demineralised water. Then, this mixture was deposited on the upper sieve of the sieve tower followed by a wash-up with 10 l demineralised water using a spray gun and a water pressure of 1 bar. Next, the sieves with material were dried overnight in an oven at 65°C, cooled down in an exsiccator and weighed again. The dry amount on each sieve was expressed in percent of the total sample dry weight. The latter was obtained by drying the rest of the faeces sample in an oven at 65°C to constant weight. The fraction of the material washed through the finest sieve was calculated from the total sample dry weight minus the sum of the 6 sieve fractions. Beside the particle size distribution, the mean particle length was calculated as the sum of the products of each sieve fraction with the median pore size (average $i^{th}$ and $(i+1)^{th}$ sieve).

Descriptive statistics for both groups were performed using the proc univariate procedure in SAS (SAS 9.2). The mean faecal particle size and the faecal particle size distribution were compared between the two groups by using a general linear model (proc GLM in SAS 9.2). Assumptions for normality for these variables were proven. The non-parametric Mann-Whitney U-test was used to compare dental pathology score between case and control animals. Spearman correlation coefficient was calculated between dental pathology score and mean faecal particle size. For all statistical procedures a significance level of <0.05 was used.

**Results / Findings**

37 horses were included in the case (n = 20) and control (n = 17) study groups. Randomisation was done optimal as no differences were found for the factors age and gender in both groups ($p = 0.801$ and chi-square = 0.316 respectively). Results for faecal particle size distribution, mean faecal particle length and dental pathology score are illustrated in Table 1.

Table 1. Results for faecal particle size distribution (%), mean faecal particle length and dental pathology score for case (impaction colic) and control study groups.

A statistical significant difference ($p = 0.030$) was found between both groups for mean faecal particle size while this was not the case for the individual faecal particle fractions. The fraction containing the longest fibres (sieve 4.75mm) was markedly higher in case (0.82%) than in control horses (0.41%) but no statistical significance could be detected ($p = 0.267$).
Horses with impaction colic tended to have higher dental pathology scores (median 2) compared to control horses (median 1) (p = 0.0513).

We did not detect a significant correlation between dental pathology score and mean particle length or particle size distribution in the examined faecal samples.

**Discussion**

Reducing feed fibre length increases the passage rate of ingesta through the equine intestinal tract (Van Weyenberg et al., 2006). Ingested long food fibres take more time to pass the guts which is a physiological response to compensate for a more difficult digestion. The preliminary results of this study did not illustrate any associations between faecal particle size distribution and the prevalence of large colon impaction colic. In contrast, control horses showed higher mean particle length in their faeces compared to colic horses. This can be explained by differences in food regimen between animals and the influence of several other risk factors identified to increase the prevalence of impaction colic such as antiparasitic therapy, stabling, changes in exercise programs and recent travelling (Hillyer et al., 2002). The limited number of animals also limits the study’s statistical power.

Specific dental pathology such as cheek teeth diastemata, missing or worn teeth and soft tissue ulcers have recently been identified as significant risk factors for development of impaction colic in donkeys (Cox et al., 2009). As the severity of the encountered tooth pathology in the present study remained moderate this could restrict its negative influence on the mastication quality and subsequent fibre length of the ingesta. Little further changes in the fibre length occur once they arrive in the gastrointestinal tract, which accentuates the importance of the mastication process possibly influenced by a dental related critical point of oral pain (Carmalt and Allen, 2008). Nevertheless, as hypothesised, case horses showed higher dental pathology scores, a finding which was marginally insignificant.

The present study did not find any association between dental pathology score and mean faecal particle length or faecal particle distribution as Carmalt and Allen (2008) also reported. This indicates that horses in the present study were efficient at breaking down food regardless of their dental pathology score, again illustrating the limited impact of the encountered tooth pathology.

**Conclusions**

The preliminary results from this study rejected the hypothesis that horses diagnosed with large colon impaction showed higher mean faecal particle length. Although no correlation was found between faecal particle size distribution and dental pathology score, impaction colic horses tended to have worse quality dentition.
References

The Effect Of Floating On Fecal Fibre Length In Working Equids

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Floating, or removal of sharp enamel points, is widely considered to be an important aspect in routine care of the horse. Reasons given for performing dental floating include improved feed utilization as well as increased comfort and longevity both of the teeth and of the horse. Two previous studies (Ralston 2001, Carmalt 2004) found that routine dental floating did not significantly change feed digestibility or fecal fibre length. Both of these studies, however, were performed on horses in good condition with only minor dental lesions, and with good quality feed.

In the developing world, working equids are not often afforded routine dental care or good quality feed. A previous study (DuToit 2008) of dental disease in working donkeys showed a significant prevalence of dental disease. The aim of this study is to examine the effect of routine dental floating on fecal fibre length in a population of working equids (horses, donkeys, and mules). It is anticipated that there may be more significant dental disease present than in the previous floating studies. This study is intended as a pilot study to investigate effects of routine dental care on underserved equids.

This study is underway, and data collection and analysis is expected to be completed by July of this year and will be able to present our results in time for the congress.
The Effect Of Dental Floating On The Healing Of Buccal Erosions And Lacerations In Working Equids

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Buccal erosions, ulcerations and lacerations are a relatively common finding in equids, particularly in association with sharp enamel points. (Carmalt 2004, DuToit 2008, Anthony 2009) Buccal mucosal erosions in humans are known to be painful, and it is therefore assumed that the same conditions in equids would also be painful. An additional consideration in working equids is the use of bridles and halters which could potentially add to the incidence of buccal injury by pressing the soft tissue into the sharp enamel points. Removal of sharp enamel points is the main purpose of routine dental floating. A previous study of dental floating (Carmalt) did not find an improvement in soft tissue ulceration after removal of points in non-working horses.

The intent of this study is to investigate the effect of routine dental floating on the healing or the persistence of buccal erosions and lacerations in working equids.

This study is underway, and data collection and analysis is expected to be completed by July of this year and will be able to present our results in time for the congress.
**Modified Buccotomy as a new surgical access to Equine Cheek Teeth**

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The well known buccotomy provides lateral access to the teeth with the numbers 06, 07 and 08 in the lower and the upper arcade. The classical surgery procedure under general anesthesia starts with an approx. 5-10 cm slightly curved skin (Smiley) incision along the space between the occlusal surfaces of the premolar cheek teeth. The now created flap opens different layers of soft tissue (Epidermal tissue, M. buccinator with vertical fibres and the mucose membrane of the oral cavity). There is great danger of injuries for the facial vein, artery and the parotid ductus. After removing the lateral bone of the alveolous, at least two third of the crown should be visible for extraction.

The suture of the incision has to be done in different layers. The time of healing is usually prolonged.

The modified surgical access starts with a vertical incision (Facial Nerve !!) dorsal/ventral of the mucose attachment to the maxilla or mandible bone. Therefore almost no soft tissue is damaged. Very soon the tooth can be prepared for visualization (Fig 1).

**Fig 1.: Preparation of 207**

Another advantage of the modified buccotomy is better access to the root tips, wound healing conditions and less soft tissue damage.

**Fig 2: Alveolous bone post extraction and facial nerve**

Wound closure is quicker (short incision) and needs only two layers of tissue suture. Antibiotic supplement is necessary for 10 days.
Surgical stabilization of a fracture of the mandible, premaxilla and palatine processes in a foal

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Introduction
Mandibular and maxillary fractures rostral to the cheek teeth are common in horses and frequently occur as a result of trauma. Mandibular fractures occur most commonly in the incisive area and interdental space (Belsito and Fischer 2001). The palatal fissure due to a trauma and to a fracture of process palatines is mentioned only sporadically in the literature. The lesion of hard palate is rare and associated with a severe trauma of the head (Baker and Easley J, 1999). When an oronasal fistula incurs, surgical treatment is indicated. Surgical repair is indicated in cases of unstable, displaced or bilateral fractures, malocclusion or inability to eat. Several methods of mandibular fracture fixation in the horse have been reported and including: intraoral wiring, intraoral wiring with acrylic reinforcement, screws and wires, intraoral application of U-shaped-bar (Gabel 1969, Krahwinkel 1969), external fixators and internal fixation using lag, screws or plates (Auer 2006, Henninger et al. 1999). The objectives of surgical treatment are to restore the ability to eat with a correct malocclusion, preserving dentition. Delay or failure to repair these fractures may results in malocclusion, tooth loss, poor cosmetics due to an increased callus formation, osteomielitis and loss of function (Henninger et al. 1999).

History
A 7 month-old anglo-arabian foal had fractures of the rostral portion of the mandibula and the premaxilla together with a completely absence of inferior incisive teeth, as a result of a trauma. The foal presented moderate pain, inappetence, malodorous breath, bilateral epistaxis and protrusion of the tongue. The owner reported a postprandial presence of food material trough the nostrils. This sign was compatible with a fissure in the palate. Radiographic examination confirmed the presence of a displaced and unstable interdental space fracture of both maxilla and mandibular symphesis and a loss of all inferior incisive teeth associated with an important lack (defect) of the rostral portion of mandibulary bone.

Figure 1. Dorsoventral view of the premaxila, showing a displaced interdental space fracture of both maxilla and a fracture of the palatine processes.

Treatment and outcome
Antibiotics, tetanus prophylaxis and ranitidine were administered to the foal before surgery, performed under general anaesthesia with isoflurane.
Figure 2. Image of a 7 month-old anglo-arabian foal showing a completely absence of inferior incisive teeth and a defect of mandibular bone fragments were removed and alveolar incisive processes were cleaned and the wounds debrided and lavaged. We used a cerclage wire to repair de mandibular symphisis fracture.

Figure 3. Image showing the fissure in the palate and the repair of the mucosal defect in the rostral portion of the mandibular bone

Oral mucosal defects were sutured to remodel the rostral portion of mandibular bone using collagen membrane between the bone and the oral mucosa. The bilateral fracture of the maxilla was stabilized with an intraoral aluminium U-bar (5 mm diameter), fixed to the incisors, the interdental space and the second premolar teeth by cerclage wires (1.2 mm) encircling the teeth and the bar.

Figure 4. Lateral radiographic view 1 week after surgery

The palatal mucosa fissure showed a hemorrhagic area with some food debris. After cleaning we decided to suture with polidioxanone (0 USP) in a continuous pattern. To facilitate this healing we used collagen membrane between the bone and the mucoperiosteal flaps. Postoperative systemic antimicrobial medication was continued for seven days and non-steroidal antinflammatories and gastric protectors for two weeks after surgery. The foal was fed enterally through a nasogastric feeding tube for five days after surgery and subsequently with a soft diet. The nasal discharge decreased. Every week, the foal was sedated and an endoscopic examination of the upper airway was performed to rule out the possibility of an aspiration pneumonia. Radiographic control was realized weekly and normal healing of the fractures was observed.

The U-bar and the cerclage were removed 1 month after surgery in order to allow normal growth of bone. During the surgery, the oral examination showed a closure of the rostral mandibular with a healthy granulation tissue and a small oronasal fistula in the rostral portion of the palate was still present. In this case we made two releasing mucoperiosteal incisions to decrease tension repairing the defect with interrupted sutures with polidioxanone (0 USP).

Figure 5. Lateral radiographic view 1 month after surgery. Normal healing with callus formation of the fracture site can be seen.

Manual examination demonstrated complete stabilization of the fractures. The nasal discharge disappeared totally and the weight had gradually increased.

Two weeks after the second surgery, healing had progressed satisfactorily and the foal was sent home.

Discussion

The diversity of fracture configurations, the age, the extent of soft tissue trauma, the duration of the injury and the loss of teeth are sufficient factors to decide the surgical technique.
Reabsorbable collagen membrane is used in guided tissue regeneration and guided bone regeneration procedures in oral surgery to assist in wound healing. The use is designed in the granulating stage of wound repair. Many authors affirm that collagen membrane can be used for guided bone regeneration to promote the bone repair process, and the promotion acts mainly at early stage of bone healing (Sai and Babu 2000). Feeding via nasogastric tube was necessary in the first week to make possible the healing of the palate suture.

Repair using wires is a successful technique to stabilize the mandibular symphysis fracture. Intraoral wiring is inexpensive and the damage to neurovascular structures and tooth roots or dental buds is minimal.

Complete and unstable fracture of the premaxilla has a tendency to collapse following reduction and need a more rigid external support than the stiffness offered by wire fixation alone. We think that the U bar can be applied with minimal soft and dental tissue damage, preserving future dentition. The application of an intraoral acrylic splint was considered unsuitable in this case, due to the excessive instability of the maxillary fracture.

The eruption of permanent incisors teeth occur, depending on the breed, at 2,5 and 3,5 years (Arabian and Standardbred horse (Baker and Easley, 1999). The dental germs of permanent incisors occupy part of the mandible and maxilla and is impossible to know if the fracture and the loss of mandibulary bone damaged the dental germs. A future radiographic control might determine the presence of permanent incisive teeth. The postoperative period shows that the foal donâ€™t lose the ability to prehend and masticate feed but exist the hypothesis that a severe malocclusion of incisors may result in reduced prehensile ability, particularly on short pastures. Another potential possibility is the development of brachygnatism described in foals with fractures involving the mandible (deBowes 1996).

The application of a U bar anchored with stainless steel wires was considered the best choice of treatment in this case.

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Saturday, September 25th
A retrospective study of odontogenic tumors and focal fibrous hyperplasia involving 152 dogs (1995-2005) presented to the University of California, Davis was performed to identify clinical pathological correlations.

Objectives: To identify any clinicopathological correlation associated with the most common odontogenic tumors and focal fibrous hyperplasia of the dog.

Design: Retrospective study
Animals: 152 dogs

Procedures: Information was collected from records including breed, age, sex and location of lesion in the oral cavity. Histological slides pertaining to each patient were reviewed by 3 of the authors. Statistical analyses were applied to the clinicopathological features of the three most common lesions; canine acanthomatous ameloblastoma (CAA), peripheral odontogenic fibroma (POF) and focal fibrous hyperplasia (FFH).

Results: 152 dogs with odontogenic tumors or focal fibrous hyperplasia were identified between 1995 and 2005. The included cases consisted of 68 (44%) CAA, 47 (31%) POF, 24 (16%) FFH, and 13 (9%) were other odontogenic tumors. The distribution of the three 32 most common lesions within the oral cavity was significant; CAA was most common in the rostral mandible, POF and FFH in the rostral maxilla. The sex predilection was found to be significant. Males and females are equally represented for CAA and FFH. Castrated males are more predisposed to POF. Golden retrievers, Akitas, cocker spaniels, and Shetland sheep dogs were overrepresented for CAA. No breed predisposition was noted for FFH or POF. Dogs with FFH presented at a greater mean age than dogs with CAA or POF.

Conclusion and clinical relevance: CAA, POF and FFH have distinct clinical patterns that add to the knowledge of clinical pathological correlations available to clinicians and pathologists.
Odontogenic cysts

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Objectives: To identify the types of odontogenic cysts and their clinical-pathologic correlations in the dog

Design: Retrospective study

Animals: 41 dogs

Procedures: Information was collected from records including breed, age, sex and location of lesion in the oral cavity. Histological slides and full-mouth radiographs pertaining to each patient were reviewed by the authors. Statistical analysis was applied to the clinical-pathologic features of the most common lesion, the dentigerous cyst.

Results: 41 dogs with odontogenic cysts were identified between 1995 and 2010. The included cases consisted of 29 dogs with dentigerous cysts, 1 radicular cyst, 1 periodontal cyst, and 1 gingival inclusion cyst. In addition, 9 odontogenic cysts were identified whose clinical behavior and histological features were suggestive of, but not diagnostic for odontogenic keratocyst (keratocystic odontogenic tumor) in humans based on strict pathologic criteria; these lesions were all found on the maxilla surrounding the roots of normally erupted teeth. Six dentigerous cysts were associated with unerupted canine teeth and 30 were associated with unerupted first premolar teeth, predominately of the mandible. One dog had a dentigerous cyst associated with an unerupted canine and first premolar tooth. Four dogs had bilateral first premolar dentigerous cysts and 1 dog had 3 dentigerous cysts. Dentigerous cysts were identified in a variety of breeds but brachycephalic dog breeds were overrepresented.

Conclusion and clinical relevance: A variety of odontogenic cysts occurs in the dog. Dentigerous cyst has a distinct clinical pattern that adds to the knowledge of clinical pathological correlations available to clinicians and pathologists.


Oral Tumours Presentation At A Private Referral Facility Since 2000

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Since mid 2000, 157 tumours presented at the dental department of Canada West Veterinary Specialists and Critical Care Hospital. Of those, 154 were identified. Starting in 2003, the protocol followed was derived from the article written by Dr. Mark Smith. It consists of obtaining recent blood work, 3 thoracic x-ray views, CT scan of maxillary masses, dental x-rays of mandibular masses, biopsies of the masses, and harvesting of the appropriate lymph nodes. This data was gathered at the first consultation and we proceeded to surgery only after receiving histological evaluations. Of the 154 presentations, 106 went to surgery. They were 43 mandibulectomies, 48 maxillectomies, and 15 others facial surgeries. 54 of them came back with clean margins.

Benign masses (epulides, cysts, focal fibrous hyperplasias, peripheral odontogenic fibromas) were not included. The exception being ameloblastomas, that even though they do not metastasize they are locally invasive and destroy bone.

Table 1 lists the types of tumours diagnosed in dogs and cats.

<table>
<thead>
<tr>
<th>Tumour Type</th>
<th>Count</th>
<th>Tumour Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenocarcinoma</td>
<td>1</td>
<td>Multilobular Tumour of the Skull</td>
<td>2</td>
</tr>
<tr>
<td>Ameloblastoma</td>
<td>23</td>
<td>Myxosarcoma</td>
<td>1</td>
</tr>
<tr>
<td>Carcinoma</td>
<td>1</td>
<td>Osteosarcoma</td>
<td>15</td>
</tr>
<tr>
<td>Chondrosarcoma</td>
<td>4</td>
<td>Plasmacytoma</td>
<td>6</td>
</tr>
<tr>
<td>Fibrosarcoma</td>
<td>24</td>
<td>Round Cell Tumour</td>
<td>2</td>
</tr>
<tr>
<td>Lymphosarcoma</td>
<td>3</td>
<td>Squamous Cell Carcinoma</td>
<td>43</td>
</tr>
<tr>
<td>Mast Cell Tumour</td>
<td>4</td>
<td>Schwannoma</td>
<td>3</td>
</tr>
<tr>
<td>Melanosarcoma</td>
<td>22</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ameloblastoma
Age range: 21 months to 13 years
Mean: 8 years
16 males, 7 females,
100% dogs
13 mandibles, 9 maxillas
One year survival: 100%
Two year survival: 95%

Fibrosarcoma
Age range: 5 to 16 years.
Mean: 9.5 years
12 males, 12 females
Maxillas 20, mandibles 4
21 dogs (87.5%), 3 cats (12.5%)
Surgery performed on 20
One year survival: 80% (16/20)
Two year survival: 61% (11/18)

Melanosarcoma
Age range: 7 to 19 years
Mean: 11.7 years
10 males, 12 females
100% dogs
Maxillas 8, mandibles 8, surgery on 16
One year survival: 50%
Two year survival: 25%

Osteosarcoma
Age range: 7 to 14 years
Mean: 10 years
8 males, 7 females
100% dogs
Surgery performed on 7 only.
One year survival: 46%
Two year survival: 33%

Plasmacytoma
Age range: 1.5 to 12 years
Mean: 7.9 years
3 males, 3 females
100% dogs
Maxillas 3, mandibles 3
One year survival: 100%
Two year survival 100%

Squamous Cell Carcinoma
Age range: 5 months to 17 years
Mean: 9.8 years
20 males, 23 females
28 dogs (65%), 15 cats (35%)
Surgery performed on 27
Maxillas 11, mandibles 13, other 3
One year survival: 60% for dogs but only 33% for cats Two year survival: 57% for dogs but only 17% for cats Average survival without surgery: 3.5 months (9 were followed) Points of interest: Survival times are longer than in older reports. Melanoma is not the most common oral tumour in dogs, SCC is, as it is in cats. Fibrosarcoma is second and melanoma is third.
Mandibulectomy in cats and dogs

Alexander M. Reiter, Dipl. Tzt., Dr. med. vet., Dipl. AVDC, EVDC

Invasive lower jaw tumors require radical resective surgery (mandibulectomy) to provide a cure. Combined therapy (surgery plus radiotherapy and/or chemotherapy) may be indicated, particularly for tumors with regional or distant metastasis. The treatment of choice for most of the lower jaw tumors is wide surgical excision. Large portions of the lower jaw and associated soft tissues can be removed without much compromise of quality of life. 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 and magnetic resonance imaging). The client must be informed about intra- and postoperative complications, follow-up care, expected long-term function and quality of life, and prognosis.

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; marginal mandibulectomy [rim excision]), 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 usually 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 mandibular symphysis causes the two remaining mandibular sections to ‘float,’ which is functionally and esthetically acceptable.

Mandibulectomies are often performed in lateral or dorsal recumbency. A mouth prop may be placed between the teeth on the normal side to slightly open the mouth. Nerve blocks are performed with 0.5% bupivacaine. The skin over the surgical area is clipped and antiseptically prepared, and the oral cavity is rinsed with 0.2% chlorhexidine solution. Sterile towels are used to separate and outline the surgical field. Resection should include 1 to 2 centimeters of clinically and radiographically healthy tissue surrounding the tumor. The use of electrocoagulation along the incised mucosal edges that will be sutured is to be avoided.

When performing unilateral mandibulectomies, the mandibular symphysis is incised with a scalpel blade and separated with a chisel and mallet. In the case of partial mandibulectomies, bone is cut with power instruments (rotating burs; sagittal and oscillating saws) or with 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. This allows leaving neurovascular structures intact within the mandibular canal, and vessels can safely be ligated prior to transaction.
In the case of total mandibulectomies, the lateral attachments of the tongue (genioglossus and hyoglossus muscles) are separated, leaving the mandibular and sublingual ducts intact if possible, which frees the mandible so that it can be swung independently. The lip commissure may be incised caudally, which greatly facilitates dissection of the masseter and pterygoid muscles from their attachments. These muscles are reflected laterally and medially, thus exposing the ramus of the mandible. The rostral attachments of the pterygoid muscle are dissected carefully to not transect the mandibular artery, which is ligated and cut where it enters the mandible through the mandibular foramen on the medial surface of the mandible. The lateral temporomandibular ligament and capsule of the temporomandibular joint are incised. The temporal muscle attachments on the rostral and dorsal edges of the coronoid process are dissected free with periosteal elevators and scissors, and the mandible is lifted out.

Hemorrhage is controlled by means of digital compression with gauze or vessel ligation. Diffuse bleeding may respond to surface application of a mixture of phenylephrine/lidocain. Other hemostatic materials include gelatin sponges, thrombin, and polysaccharide beads. Dilute epinephrine is to be avoided. Unilateral carotid artery ligation is recommended if hemorrhage continues and cannot be controlled. Displacement of a ligature is the most common cause of bleeding in the immediate postoperative period. Hemoclips should not be used to ligate significant vessels due to their tendency to fall off or tear the vessel.

The wound is rinsed with lactated Ringer’s solution and closed with buccal- and labial-based flaps that are undermined and sutured to sublingual mucosa without tension. A two-layer closure is preferred, with the first layer apposing connective tissues of the flaps, to relieve tension on the epithelial edges. The resected jaw tissue and regional lymph nodes (i.e., mandibular, parotid and medial and lateral retropharyngeal nodes) are preserved in 10% buffered formalin and submitted for histopathological examination.

After total mandibulectomy the opposite mandible will swing over toward the midline, which may result in the remaining mandibular canine tooth to impinge on the palate when the mouth is closed; to prevent this, the tooth is extracted or its crown surgically reduced. After more involved mandibulectomy procedures, the tongue will lose its ventral support and often hangs out of the mouth, resulting in drooling and chronic dermatitis. This can be partially corrected by rostral advancement of the lip commissure on one or both sides to form a fold that contains the tongue (commissuroplasty). The upper and lower lips are incised to the level of the maxillary first or second premolars, the skin is dissected from the buccal and labial mucosa, and the mucosa and skin are sutured separately in two layers, thus advancing the commissure further rostrally.

Postoperative 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. Antibiotic treatment is not required after mandibulectomies in the otherwise healthy patient. Broad-spectrum antibiotics are given perioperatively in debilitated and immunosuppressed patients.
and those suffering from organ disease, endocrine disorders, cardiovascular disease, severely contaminated wounds and systemic infections.

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 take several days to adapt. Cats will benefit from placement of an esophagostomy tube to ensure proper nutrition and medication during the immediate postoperative period. Chlorhexidine digluconate solution or gel (0.1-0.2%) is administered into the mouth for 2 weeks. Elizabethan collars, tape and nylon muzzles, or other restraining devices may be used in some animals to prevent disruption of the surgical sites. Wound dehiscence 2 to 3 days after surgery usually results from tension on suture lines or compromised vascularity of flaps. Dehisced flaps are resutured after further undermining to eliminate tension.

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.

Radical resective surgery often provides a cure in patients with lower jaw tumors and is tolerated fairly well by dogs and cats. The quality of life provided by mandibulectomy procedures is often excellent. The multiple anesthesia episodes required for radiation therapy and the systemic sickness and multiple office visits required for chemotherapy are avoided. Combined therapy may be indicated, particularly for lesions with regional or distant metastasis. A wide range of mandibulectomy procedures in cats and dogs is discussed during oral presentation.
Mandibular Osteosarcoma In A Dog - Treatment With Segmental And Caudal Mandibulectomy Combined With Chemotherapy

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Introduction
Oral tumors are the fourth most common localisation for malignant tumors in dogs and cats 1). The most common orofacial tumors of dogs are malignant melanoma, squamous cell carcinoma, fibrosarcoma, osteosarcoma, and acanthomatous epulis 2). There is some confusion about the term epulis, which is clarified in the literature by Gardner 1996 3). The malignant neoplasms are difficult to treat as they are often recognised very late. Pet owners often decline radical surgical treatment. But in combination with chemotherapy and radiation therapy for radiosensitive tumors like squamous cell carcinoma it is possible to obtain also long surviving times of veterinary patients 2, 4). History, physical examination, intraoral radiographic examination and biopsy are used to obtain a definitive diagnosis. For the extent of the lesions CT-scan and MRI can be used.

Case presentation
A 12 year-old large mixed dog (Ronja, female, neutered) was referred with a bleeding oral lesion in the right mandible in february 2009. An excisional biopsie revealed an Osteosarkoma, but the owner was not willing to go for surgery. The referring veterinarian treated the dog with antibiotics and pain medication. 2 month later in april 2009 the tumor was growing larger and larger. So the owner came back to remove the tumor of the dog.

Surgical therapy: At that time the owner was still very sceptic to do major surgery - but after diagnosis with intraoral radiography (lucency around 409 extending to 407 and 410) and intense discussions he accepted at least to remove the part of the mandible with the tumor - so partial segmental mandibulectomy was performed. Thoracic radios revealed no abnormality. The surgery consisted in resection of the affected part of the right mandible from 407 to 410. First 407 and 410 were extracted and then the mandible was cutted in the extraction sites with a high speed bur. After ligation of the mandibular artery distally and mesially the "bloc" was removed. Pain management was done with butorphenol and meloxicam. The dog recovered very well and could be discharged the same day. Already 5 hours after surgery Ronja was occluding well the frontal rest of mandible. Recovery the next days was very quick and the dog was well eating from the first day after surgery.

Histology confirmed the osteosarkoma with fibrosarkoma structures in the soft tissue.
As the dog was in perfect condition and in accordance with the University of Veterinary Medicine Vienna - oncology department - I decided to go for chemotherapy to prevent recurrence. After complete blood count chemotheraphy was started in may 2009 first with carboplatin 300mg/m². Under control of the blood count and recovery of neutrophils the
next cycle of chemotherapy consisted in doxorubicin 30mg/m². After this second cycle the diminution of neutrophils was less severe (2.8 G/l). 2 month post operation the intraoral suture showed still some nodal reaction. Histology resulted in granulation tissue. The third chemotherapy at that time was done with doxorubicin 30mg/m². After the third chemotherapy the neutrophils dropped down to 0.4 G/l so antibiotics were given orally. 14 days later neutrophils (6.2 G/l) and leucocytes (8.8 G/l) were in a normal range. Then the 4th cycle of chemotherapy was done with carboplatin 300mg/m². The blood count 11 days later showed less decrease of the neutrophils (1.7 G/l). Further blood counts 2 month later were in a normal range (4.7 G/l neutrophils). At the end of 2009 the dog came with pain and swelling on the caudal rest of the right mandible. In anaesthesia the last tooth of the mandible (411) and the counterpart at the maxilla (110) were extracted, a biopsy taken and steroids administered. The biopsy came out with "plausible osteosarcoma". The thoracic radios were still normal and the dog otherwise in good health.

Second surgery: In agreement with the owner the whole part of the right caudal mandible was removed. After enlarging the right lip commissure and incision of the oral musosa soft tissue and muscles were removed from the horizontal ramus, the processus angularis and the processus condylaris. After removal of mastication muscles from the vertical ramus and the processus coronoides it was possible to incise the TMJ and luxate the caudal rest of the mandible. After haemostasis the caudal part of the mandible could finally be removed. The intraoral mucosa was closed with buried Monosyn 1,5 metric sutures. Subcutis was adapted with absorbable Safil 1,5 metric and the external wound including the lip commissure was sutured with non absorbable Supramid 2 metric in single interrupted pattern reconstructing the original lip structure. Pain management was sufficient with butorphenol and meloxicam and the 12y3m old mix dog recovered very quickly. The occlusion of the frontal part was even better as before surgery. The dog was eating the next day almost normal, only drinking was reported to be more difficult and the dog was drooling. 6 day POP some swelling was present, but went back to normal after one subcutaneous application of steroids. 11 days POP the sutures were removed and the dog was eating and drinking almost normal without remarkable drooling.

Discussion
Veterinarians dealing with malignant oral neoplasm are often faced with the difficulty to CONVINCE the owner to go for "main massive" surgery like mandibulectomy or maxillectomy. Results of studies demonstrated that partial mandibulectomy was effective in prolonging survival and decreasing recurrence for squamous cell carcinoma and ameloblastoma. The high rates of recurrence and metastasis in dogs with melanoma, osteosarcoma, and fibrosarcoma suggest a need for evaluation of ancillary chemotherapy and local radiation therapy to decrease the prevalence of progressive disease 5). Salisbury 6) cite partial mandibulectomies for malignant oral tumors as possible procedure, a central hemimandibulectomy is mentioned. Other authors recommend total mandibulectomy for malignant oral neoplasms 7, 8). A slight discoloration of the kept rostral canine 404 is present like mentioned in the literature 9). In the presented case therapy with two partial mandibulectomies combined with chemotherapy resulted in a normal life for dog and owner over more than 13 month.
References

Bilateral gingival mass found on labial gingiva of upper canines of a 14yrs old female Siberian husky

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1 Vettec Dentistry:
2 Ogi animal clinic:
3 Minami animal hospital:
4 Section of oral pathology diagnostic, Nippon dental university:

A fourteen-year-old spayed Siberian husky dog was referred for bilateral gingival mass of upper canines. The dog was not clearly showed any discomfort or pain, but the owner concerned their growth. Gingiva except around upper canines looked normal without overgrowth or recession. Oral X-ray examination of the firm gingival mass of right canine prior to biopsy showed some bone spikes from the lesion with no broad bone loss under the lesions and no gingival pockets around them. Ossifying fibroma on the right and epidermoid cyst on the left were confirmed by histopathology of extracted teeth with gingival and buccal alveolar bones.

A dog had bilateral gingival mass of canine teeth. Mass grew relatively fast before and after the biopsy. Two different pathologies were resulted from the lesions. The one is ossifying fibroma and another is epidermoid inclusion cyst. Both pathologies were not serious but were very commonly diagnosed in veterinary oral surgery.

Signalment: A fourteen-year-old spayed Siberian husky

Oral examination: Mild gingivitis with thin layer of calculus was generally observed in the oral cavity. There was no sign of gingival over growth except gingival masses on both canine teeth. The firm mass was on the buccal gingiva of the right canine. Oral X-ray examination of the firm gingival mass of right canine showed some bone spikes from the lesion with no broad bone loss under the lesions and no gingival pockets around them. The left one was a soft ulcerative lesion with no bone loss of adjacent alveolus and pocket formation.

Biopsy prior to extraction: Biopsy resulted was very much likely ossifying fibroma on the right. Gingival mass was continuously growing and firmly attached on the attached gingiva. To remove the gingival masses, the upper canines should be extracted with buccal alveolar bone.

Treatment: Mucogingival flap was made followed by making groove around canine roots alveolus bone. Careful extraction was performed without formation of iatrogenic oronasal
fistula. Immediately after the extraction en bloc segments were immersed in the 20% formalin.

**Histopathology:** Samples were examined by human oral pathologist and veterinary pathologist. Ossifying fibroma was diagnosed on the right gingival mass. The mass was consisted by irregularly arranged fibrous bundles, rich vascular networks and fibrous bone. Hypercementosis and regional ankylosis were found on the root of the right canine with very subtle inflammation. Epidermoid cyst was diagnosed on the left gingival mass. The inclusion cyst was lined by orthokeratinized stratified squamous epithelium. Keratinized material filled in the cystic cavity. Mild to intermediate inflammatory cell inclusion was observed under the membrane. Partly membranous loss made alveolar bone exposed to the oral cavity to enhance reactive fibrous bone formation.

**Discussion**

It has been said that ossifying fibroma, a benign neoplasm of bone, is rare tumor in dogs and in human as well (1,2). Also in human oral pathology juvenile one behaves in a more aggressive fashion rather than adult one (2). One report of dog was recurrent (3), seemed that this was a clinically aggressive lesion. Since it removed, no recurrence has been found.

Causes of epidermoid cyst is mainly developmental or acquired inclusion of epidermis or dermis into sub-membranous connective tissue(4,5,6). In human oral cavity the cysts are developed at the floor of oral cavity, lip, buccal membrane and tongue (4). The typical histologic feature of the cyst is ortho-keratinized stratified squamous epithelium lining of the wall without appendix of skin(5,6).

**References**

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113
A NINE DAY ACCELERATED RADIATION PROTOCOL WITH CONCOMITANT CARBOPLATIN FOR TREATMENT OF MANDIBULAR ORAL SQUAMOUS CELL CARCINOMA IN A CAT

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INTRODUCTION
A 12 year old female, rag doll cat weighing 3.1 kg was referred to Animal Hospital Postojna, Slovenia for the treatment of a confirmed mandibular squamous cell carcinoma (SCC). The cat had had a mammary adenocarcinoma removed several months previously.

Further diagnostic workup included physical examination, complete blood count (CBC), serum biochemistry, thoracic radiography, abdominal ultrasound, lymph node assessment and oral radiography did not detect serious systemic complications or evidence of metastasis, but there was a small recurrent subcutaneous mammary tumour on the cat's thorax.

The jaw tumour was located on the caudal left mandible, affecting the premolar and molar region with significant bone involvement evident on radiography.

TREATMENT
As surgery for a tumour in this location was very unlikely to leave clean margins this option was not considered appropriate. Combination chemotherapy is only beneficial in a proportion of SCC cases, and there is little documentation of it prolonging life expectancy, so this was mentioned to the owner but not advised. Conventional radiotherapy protocols have had limited success, but there are now protocols that have been shown to induce good remissions and prolong life expectancy in cases with no, or minimal, metastatic disease. One such is an accelerated protocol developed by Fidel and co-worker, who are using carboplatin as a radiosensitiser, administering it twice at an interval of 4-7 days in association with a 14 x 3.5Gy fraction, twice daily (5 to 7 days per week depending upon weekend availability) radiotherapy regime
This was suggested to, and accepted by the cat's owner.
For each treatment the cat was premedicated with 0.025 mg medetomidine intravenously and standard fluid therapy started. Carboplatin (90 mg/m2) was administered intravenously
immediately before the first and eighth radiation dose (4.5 days later). 6 hours were planned between fractions to allow normal tissue repair.
A light plane of anaesthesia was induced using intravenous propofol to effect, and the cat intubated. The duration of anaesthesia from the induction was sufficient for the short period required for radiotherapy, maintained using isofluorane in air supplemented with oxygen being used for both the placement of an oesophagostomy tube at the start of therapy (as a precaution against the need for assisted feeding should there be significant oral mucositis) and for the later excision of the recurrent mammary mass. Medetomidine was antagonised with the same dose of atipamezole after each radiotherapy.

OUTCOME
The oral tumour was noticeably smaller by the 5th day of treatment and had practically disappeared by day 28, only a small benign appearing swelling remaining adjacent to the molar salivary gland. Although expected, mucositis was not clinically evident during or after treatment. There were no signs of reluctance to eat, so the oesophagostomy tube was removed after 2 weeks.

DISCUSSION
Oral neoplasia account for approximately 10% of all feline tumors (1). The most common cancer of the feline oral cavity is SCC with an estimated incidence of 60-70% of all oral tumors (1,2). Feline oral SCC is a locally aggressive neoplasm that may arise from the lips, cheeks, tongue, oropharynx or gingiva (1,3).
Affected cats are presented for signs such as anorexia, weight loss, ptyalism, loss of teeth, signs of oral pain or difficulty in food intake and mastication (2). Although metastasis to regional lymph nodes and lungs is reported, aggressive local tumor growth presents the most significant obstacle to successful management of this disease (2).
Reported treatment options for feline oral SCC include surgery, radiation therapy and chemotherapy or a combination of these modalities (4). Even with aggressive treatment the expected survival time for affected cats is 2 - 4 months, with a 1 year survival rate of less than 10% (2,3). The main problem is the advanced stage at which the cancer is diagnosed (2,3). As radiotherapy alone is generally ineffective in the management of feline oral SCC, new radiation protocols are under investigation (4). As it is known that these types of cancers have rapid doubling time of probably only a few days so, to be effective the radiation dosing interval needs to be short (3,4,5).
An accelerated protocol developed by Fidel and co-workers (described earlier but without use of a radiosensitiser) resulted in minimal radiation side effects, but overall median survival was only 86 days (4).
Modification of the protocol to include two doses of carboplatin as a radiosensitiser resulted improved tumor control, with the median survival increasing to 163 days (5).
Unfortunately despite the excellent short term response and lack of side effects, our case went on to develop metastatic adenocarcinoma and died two months following treatment of the SCC.
CONCLUSION
Advanced tumors of the head and neck are rarely candidates for aggressive surgery due to serious loss of function for the patient or unacceptable adverse cosmetic effects for the owner. Lack of effective chemotherapy protocols leaves radiation therapy as the best treatment option. Acute and chronic side effects of radiation therapy are generally well tolerated by pets. With the development of new accelerated protocols using radiosensitisers side effects are minimised and effectiveness maximised making this a promising method for the treatment of feline oral SCC.

REFERENCES
Total Mouth Periodontal Score System In Cats

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Development of a Total Mouth Periodontal Score in cats to facilitate clinical periodontal scoring in trials investigating results of periodontal treatment or the relationship between severity of periodontal disease and systemic/distant organ effects or of periodontal disease and other oral conditions such as tooth resorption.

A Total Mouth Periodontal Score (TMPS) system using weighted contributions of specific teeth based on gingival circumference (for gingivitis scores) and root surface area (for periodontal attachment loss for periodontitis) was recently reported in dogs. Use of the TMPS spreadsheet results in a validated and repeatable single gingivitis or attachment loss score representative of the extent of periodontal disease present at the time of examination. TMPS facilitates clinical periodontal scoring in trials investigating results of periodontal treatment or the relationship between severity of periodontal disease and systemic/distant organ health or of periodontal disease and other oral conditions such as tooth resorption.

This presentation will report the results of the TMPS measurement system applied to cats, based on digital image measurements of teeth from several cat cadavers with intact dentition. Compared with dogs, there is a wider range of size of teeth. Several teeth that would be difficult or impossible to score individually for gingivitis or attachment loss (maxillary and mandibular incisors, maxillary second pre-molar, first molar teeth) were not included in the TMPS calculations. The spreadsheet utilizing the weighting system in cats will be demonstrated.

Reference:
New Insights Into The Complexities Of Periodontal Disease And The Chronic Inflammatory Process

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Although initial blame for the development of periodontal disease can be placed on the presence of periodontal pathogens, it would be short sighted to merely assume antibiotic therapy alone would halt the progression or reverse the disease. It would be easy to assume that periodontal pathogens produce a simple cause and effect response (i.e. if the patient harbors the bacteria, then the patient develops the disease). But, recent investigations suggest a far more complicated picture of periodontal disease and the accompanying systemic inflammatory response. One that is effected by not only the virulence of the bacteria, but the genetically determined inflammatory response of the host, the current disease status of the host, the nutritional status of the host, and even environmental exposures to the host.

A recent study examined the inflammatory response of mice to A. actinomycetemcomitans. (1) Two strains of mice were used in the study. One strain had been selectively bred to produce a maximal inflammatory response (AIRmax), and the other to produce a minimal inflammatory response (AIRmin). AIRmax mice exposed to a 45 day infection of A. actinomycetemcomitans demonstrated significantly more alveolar bone loss with higher local leukocyte counts than comparably exposed AIRmin mice. In additional, AIRmax mice demonstrated significantly higher levels of Interleukin 1-beta (IL-1 β), interleukin-17 (IL-17), and tumor necrosis factor-alpha (TNF-Î±) than their AIRmin counterparts. Locally, the actual bacterial load found invading the soft tissues was comparable for both strains despite the fact that the AIRmax mice were producing measurably higher levels of antimicrobial mediators myeloperoxidase and nitric oxide synthetase. Systemically, there were no significant differences in levels of immunoglobulin G directed against A. actinomycetemcomitans between the AIRmax mice and the AIRmin mice. The researchers concluded that a genetic predisposition for an exaggerated inflammatory response didnâ€™t necessarily place the individual at any advantage for controlling infection. It resulted in remarkably greater local tissue destruction, and very likely placed the host at greater risk for systemic complications.

Certainly, the systemic effects from the virulence factors of lipopolysaccharide are striking. It induces macrophage activation and the production of inflammatory mediators. It stimulates platelet aggregation and monocyte adhesion to endothelial cells. It promotes the development of cholesterol laden macrophages termed â€œfoam cellsâ€ by down regulating transmembrane proteins responsible for cholesterol efflux from macrophages. (2) The consequences of this can be severe, as these changes can lead to infection induced atherogenesis and thromboembolism.

A recent Harvard study examined atherosclerotic lesion formation in the aortic walls of rabbits fed high fat diets containing 0.5% wt/wt cholesterol. (3) Both test and control groups
were fed the high fat diets. Ligature induced periodontitis was produced in the mandibular 2nd premolars of the test group, with a slurry containing Porphyromonas gingivalis applied to the ligature sites 3 days per week for the first seven weeks. The control group received a slurry application devoid of P. gingivalis at the same premolar sites. After fourteen weeks, the subjects were euthanized. Aortas and mandibles were harvested to evaluate atherosclerotic and periodontal lesion formation respectively. The control group showed minimal lipid deposition in the aortas, and no crestal bone loss associated with the mandibular 2nd premolars. The test group showed extensive crestal bone loss around the mandibular 2nd premolars, and extensive atheromatous plaque formation along the aortas. Remarkably, two rabbits within the test group did not develop periodontitis at the ligature sites, did not exhibit crestal bone loss, and did not exhibit atheroma formation in their aortas.

The cell wall of P. gingivalis supports outer membrane vesicles (OMVs) that contain virulence factors such as LPS, proteases, and adhesins. Studies demonstrate the aggregation of low density lipoproteins (LDL) in the presence of P. gingivalis and OMVâ€™s through the suspected proteolysis of a major protein within LDL, Apo B-100. This aggregated form of LDL becomes phagocytized by macrophages to produce â€œfoam cells.â€ Accumulation of these foam cells in the arterial intima may serve as initiating factors in the development of lesion formation, as demonstrated by the pathway:

P. gingivalis + OMVâ€™s + LDL Ï‡ Proteolysis of Apo B-100 Ï‡ LDL aggregation and phagocytosis by macrophages Ï‡ Foam cells produced Ï‡ Accumulation in arterial intima Ï‡ Lesion formation

The positive effects of high density lipoproteins (HDL) are equally striking. They act to neutralize circulating lipopolysaccharide. They protect against the oxidation of LDL. And they participate in the efflux of cholesterol from the aggregated LDL laden foam cells in the arterial intima. Not surprisingly, the role of nutrition and HDL/LDL ratios become important considerations when evaluating overall health and risk factors for disease. Oxidative stress can lead to a pathway of inflammatory mediator production, and is felt to be modified by both infection and diet. Ongoing biochemical and nutritional research has revealed insights into promising new treatment options for modifying the inflammatory response. Newly discovered lipid based mediators, derived from the metabolism of omega 3 and 6 polyunsaturated fatty acids, have demonstrated potent effects in directing the inflammatory process to a resolution phase in order to regain a state of biologic homeostasis. This is in contrast to a traditional approach of blocking the inflammatory pathway by interrupting targeted sites within the cascade of arachidonic acid metabolism.

Lipoxins, protectins, and resolvins are newly discovered pro-resolving mediators that block neutrophil chemotaxis seen in the acute inflammatory stage. They serve as chemoattractants for mononuclear cells without amplifying the inflammatory response by inducing cytokine production. The mononuclear cells serve to remove the apoptotic neutrophils and set the stage for tissue healing as opposed to ongoing, chronic inflammation. Lipoxins are enzymatically derived from the omega 6 fatty acid, arachidonic acid, while resolvins and protectins have their origins from the omega 3 fatty acids eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA) (Fish oils).
Researchers have discovered in people with chronic inflammatory diseases, including periodontal disease, there appears to be a deficiency of pro-resolution lipoxin levels in comparison to the inflammatory leukotriene levels. Studies in transgenic rabbits that demonstrate overproduction of 15-lipoxygenase and a resulting increase in endogenous Lipoxin A4 showed reduced levels of periodontitis and reduced levels of atheroma formation.(6) Using the mandibular 2nd premolar ligature in rabbits as discussed before, the same Harvard researchers discovered that applying topical treatments of ResolvinE1 (lipid derived pro-resolving mediator) to the teeth three times a week decreased the alveolar bone loss by over 95% in the face of P. gingivalis slurry application. Another study found not only a reduction in periodontal inflammation in rabbits with established ligature induced periodontitis, but regeneration of alveolar bone, cementum, and periodontal ligament tissues upon topical exposure to ResolvinE1.(8) Both vertical and horizontal bone loss was restored to pre-disease levels, along with resolution of 2nd premolar tooth mobility. In comparison, two other test groups of rabbits received topical applications of either LeukotrieneB4 (LTB4), or ProstaglandinE2 (PGE2). Both of these groups had substantially advanced progression of periodontal tissue destruction and tooth mobility.

The magnitude of the immune response can lead to excessive destruction of periodontal tissue in the face of exposure to periodontal pathogens. Having the appropriate balance of pro-inflammatory mediators with pre-resolving mediators may not exist in individuals suffering from uncontrolled, chronic disease. Genetic predisposition for overproduction of inflammatory mediators such as Interleukin 1 (IL-1) has been found to greatly influence the degree of host induced periodontal tissue destruction in the face of periodontal pathogen exposure.(9) And, as suggested from studies discussed previously, the expression of proresolving lipid mediators has the potential to greatly influence not only the extent of the acute inflammatory phase, but the degree of regeneration in the resolution phase.

So, it becomes apparent that simply the presence of a periodontal pathogen does not necessarily define disease. It is only one determinant in the development of pathology and tissue destruction. Host reaction in terms of immunologic response and inflammatory mediator production becomes a critical consideration. Nutritional status, with the presence of antioxidants, and availability of omega 3 fatty acids for adequate generation of proresolving mediators, becomes an important part of the equation. And, environmental exposure and influences certainly can’t be dismissed, as they add an entirely new dimension to the risk of developing chronic inflammatory disease.

Clearly, we are only seeing fragments of the overall picture of inflammatory disease; a complicated landscape that offers a myriad of interaction between host, pathogen, and environment. A sensitive and delicate balance exists between developing an acute inflammatory response, and proceeding with an appropriate resolving response in order to protect, and ultimately heal, the host. Research appears to be unveiling many adverse inflammatory effects within the body in association with periodontal disease. The challenge is to distinguish mere association with a true cause and effect. As understanding of these complex inflammatory diseases evolves, treatment protocols will no doubt change dramatically, and will likely involve specific approaches tailored to the genetic uniqueness of the individual.
References
Nutrients And Periodontitis-What'S New?

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Introduction
Periodontitis is an inflammatory disease that affects the supporting tissues of the teeth. It is initiated by specific bacteria within the plaque biofilm. These bacteria exert a pathogenic effect by directly destroying periodontal tissue and by modulating the host response (1). Large numbers of reactive oxygen species (free radicals) are produced during the inflammatory process contributing to further periodontal breakdown (2). Much of recent periodontal disease research focus has shifted toward managing host-mediated inflammation (3).

Good nutrition is vital to overall health. Adequate nutrition, in addition to other host factors, is necessary to maintain defense mechanisms of the gingival tissues and saliva (4, 5). The relevance of the interaction between nutrition and the progression of oral diseases in humans has been reported in a recent position paper by the American Dietetic Association that supports the integration of oral health with nutrition services (6).

Some studies have highlighted the host inflammatory response as one of the main routes of periodontal breakdown. People who were taking non-steroidal anti-inflammatory drugs (NSAIDs), which block prostaglandin E2, for arthritis or spondalitis had considerably less periodontal bone loss than the group taking no drugs (7). Also, increased collagenase has been shown to contribute to periodontal breakdown. Low dose doxycycline treatment has inhibited collagenase activity and resulted in improvement of periodontal disease (8). Because long-term use of NSAIDs or antimicrobials may result in side effects, some nutrients that block prostaglandin production and collagenase activity offer a viable and safe adjunct in the treatment and prevention of periodontitis (9,2).

Lipids
Omega-3 fatty acids have anti-inflammatory properties and their addition to diet may help reduce the inflammation associated with periodontal disease. Fish oils are highly concentrated sources of these essential fatty acids (10). Omega-3 fatty acids have helped to modulate the inflammatory response, and in turn reduce the alveolar bone loss associated with infection by P. gingivalis in rats (11, 12). Omega-3 fatty acid intake has slowed down the progression of periodontal disease in older Japanese people (13). Also, a close association between periodontitis, abnormal changes in plasma fatty acids profile and the increase in metabolic risk factors for cardiovascular diseases has been reported in man (14).

Several disorders relating to lipid metabolism of dogs and cats are similar to those in humans including obesity, diabetes mellitus, renal disease, some cardiovascular disorders, and hypothyroidism. Evidence exists to support the beneficial role of omega-3 fatty acids in renal and cardiovascular disorders in both in humans and companion animals. Fish oil supplements
in dogs appear to help preserve renal function, improve the arthritic condition, have antiarrhythmic effect and may minimize loss of heart muscle in dogs with congestive heart failure (15, 16). Use of fish oil enriched diets has been recommended as part of anti-inflammatory treatments for dogs with chronic inflammatory diseases (17). Further studies are needed to evaluate the effect of omega-3 fatty acids in canine and feline periodontitis.

**Probiotics, dairy products and calcium**

Probiotics are defined as living microorganisms that exert health benefits beyond inherent basic nutrition upon their ingestion in certain numbers. Probiotics contain live lactic acid bacteria, including members of the genera *Lactobacillus* and *Bifidobacterium* (18). Japanese people eating at least 55 g of lactic acid foods per day had a significantly lower prevalence of deep probing depth and severe clinical attachment loss compared to those not eating these foods. The intake of milk did not have a significant effect on periodontal disease. The authors concluded that routine intake of lactic acid foods may have a beneficial effect whereas calcium intake from dairy products may not have had a major impact on periodontal disease (18). Oral lactobacilli have been reported to suppress the growth of periodontal pathogens in vitro (19). Therefore, the beneficial effect might be based on the probiotic effect of lactobacilli and the regular consumption of lactic acid foods may constrain periodontal disease by controlling the overgrowth of periodontopathogens (18).

Clinical indications for probiotics use in veterinary patients are such as inflammatory bowel disease, diarrhea, chronic renal disease and pancreatitis. Probiotics have also been used to enhance general immune function in puppies (20). Will periodontal disease be added in the clinical indications list in veterinary medicine in future?

A study with over 12,000 participants concluded that subjects in the highest quintile of intake of dairy products were 20% less likely to have periodontitis than those in the lowest quintile (21). This author suggested that calcium in dairy products may have a prophylactic effect on periodontal disease. The types of dairy products (with or without probiotics) that confer a benefit on periodontal health status were not determined in the study.

Calcium deficiency is essentially unheard of in dogs and cats that consume commercial pet foods containing calcium levels that meet Association of American Feed Control Officials (AAFCO) allowances. The excessive levels of calcium and phosphorus present in many commercial pet foods and the role that these minerals play in calculus formation is a more realistic concern (22).

**Polyphenols**

Polyphenols represent a wide variety of compounds that occur in fruits, vegetables, wine, tea, extra virgin olive oil and cocoa products. Flavonoids are the most abundant polyphenols in human diets (23). Green tea contains polyphenols, particularly catechins, which are thought to improve health. The most abundant of the catechins is epigallocatechin gallate (EGCG). Intake of green tea and its components, such as catechin, has had a preventive effect against cancer development and cardiovascular disease in experimental and epidemiologic studies (24). In vitro studies have suggested that green tea catechins inhibit the growth of periodontal pathogens such as *Porphyromonas gingivalis*, *Prevotella intermedia*, and *Prevotella nigrescens* and the adherence of *P. gingivalis* onto human buccal epithelial cells. (25, 26).
Also, catechins may prevent alveolar bone resorption by inhibiting the expression of matrix metalloproteinase (MMP-9) in osteoblasts and the formation of osteoclasts (27). The collagenase activity in the gingival crevicular fluid from highly progressive adult periodontitis was completely inhibited by the addition of tea catechins (28). A pilot clinical study showed that periodontal treatment with a slow-release local delivery of catechin improved periodontal status (25).

Limited data is available about the effect of green tea consumption on periodontal disease. One recent study showed a modest inverse association between the intake of green tea and periodontal disease. The authors stated that the application of concentrated green tea components, such as catechin, may be expected to have a more beneficial effect on the periodontal condition (26).

Absorption, tissue distribution and elimination of EGCG after oral administration has been studied in dogs and results indicate that EGCG is widely distributed to tissues where it can exert a chemopreventive effect (29,30). The inhibitory effects of catechin on periodontal pathogens and MMP may provide the basis for the beneficial effect of the daily intake of green tea on periodontal health (26).

Proanthocyanidins (PAC) are polymer chains of flavonoids such as catechins. PACs are present in fruits, bark, leaves and seeds of many plants. Cranberry extracts are a rich source of A-type cranberry proanthocyanidins (AC-PACs). AC-PACs inhibit host inflammatory responses, production, and activity of enzymes that cause the destruction of the extracellular matrix, biofilm formation, and adherence of Porphyromonas gingivalis, and proteolytic activities and coaggregation of periodontopathogens. Cranberry components are also potential anti-caries agents since they inhibit acid production, attachment, and biofilm formation by Streptococcus mutans (31,32). There is strong evidence that grape seed proanthocyanidin extract could potentially protect canine lens epithelial cells from the damaging effects of oxidative stress (33). Another recent study reported that grape seed extract suppressed human matrix metalloproteinases and that it may be used in the development of host-modulating strategies for the treatment of MMP-mediated disorders such as periodontitis (34).

**Caloric restriction and exercise**

Studies using rhesus monkeys on long term caloric restriction (CR) reported that CR dampens the inflammatory response and reduces systemic markers of inflammation and as a result reduces the risk for inflammatory periodontal disease and active periodontal breakdown. CR had no demonstrable effect on the periodontal microbiota (35,36).

Increased physical activity has been associated with lower levels of periodontal disease in two longitudinal studies in man (37,38). Engaging in the recommended level of exercise was associated with lower periodontitis prevalence in adults who had had similar physical activity (or inactivity) level for at least 10 years (38). In another study men in the highest quintile of physical activity had a 13% lower risk of periodontitis compared to men in the lowest quintile (37). Possible mechanisms by which physical activity may protect against periodontitis are by increasing sensitivity to insulin, reducing inflammation, protecting against development of obesity and reducing stress (38). Future studies will hopefully prove whether caloric restriction and adequate exercise have a positive effect on canine and feline periodontal disease.
Fig. 1 Relationship between some nutrients or foods and progression of chronic periodontitis in man (4).

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Development of an image-analysis system for the measurement of dental plaque accumulation in dogs

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Introduction

Accurate assessment of the extent of dental plaque coverage on tooth surfaces is essential in periodontal research. Objective indexes are needed to evaluate the amount of plaque accumulating on tooth surfaces when studying the preventive effects of specific dental-oriented diets or chewing devices. In veterinary medicine, the Logan & Boyce plaque index (1994) is most commonly used (Gorrel, 1999; Logan et al., 2002). It has been shown that this index was inaccurate and modifications have been suggested to improve precision (Hennet et al., 2006). A gingival plaque contour index was recently described though the measurement of plaque accumulation but still needs validation (Scherl, 2009). In humans, computer-assisted planimetric measurements of dental plaque have been proposed and validated (Smith RN, 2001, Smith RN 2004)

The purpose of this study was to validate the use of an image-analysis system for dental plaque coverage assessment in dogs.

1. MATERIAL and METHODS

1.1 Material

1.1.1 Animals

Two Yorkshire Terriers, 4 Bichons frisés and 5 King Charles Spaniels dogs, 12 months of age and weighting between 2 and 8 kg were selected. They had full dentition, normal occlusion and, at most, mild gingivitis associated with dental plaque and calculus accumulation. The dogs were housed by two. Dried expanded diets were distributed (on the basis of 132 kcal/kg^0.73) and water were available ad libitum.

1.1.2 Teeths

Sixty-three teeth (13 teeth for the Bichons frisés, 15 teeth for the King Charles Spaniels and 35 teeth for the Yorkshire Terriers) were selected for the study. These included 5 mandibular canine teeth, 10 maxillary canine teeth, 15 maxillary corner incisors, 4 mandibular first molar teeth, 8 maxillary first molar teeth, 5 mandibular third premolar teeth, 9 maxillary third premolar teeth, 5 mandibular fourth premolar teeth and 9 maxillary fourth premolar teeth.
1.2. Methods

1.2.1 Methods of plaque disclosing and evaluation of plaque coverage

Dental plaque disclosing

Under general anesthesia, tooth surfaces were rinsed with water, a plaque disclosing solution [FD and C red # 3 (erythrosin)] (Reveal®, Henry Schein, Gillingham, U.K.) was applied on the crown surface of the teeth followed by rinsing and gentle drying.

Two innovative methodologies were developed: image analysis planimetric measurement and manual contouring planimetric measurement. The last method has been developed in order to validate the image analysis measurement.

Image Analysis planimetric measure:

- Step 1: Taking coloured 12.2 million pixels pictures of the maxillary and of the mandibular dental arches of the dogs according to a standard protocol including the camera equipment and position, light setting and position of the dog.
- Step 2: Manual contouring of the crown surface was performed using Photoshop® CS4 extended (Adobe Systems Incorporated, San Jose, USA) and a graphic tablet (G-Pen M712®, Genius, Taipei, Taiwan).
- Step 3: Image analysis of disclosed plaque on crown surface was performed using a specific algorithm created with the MATLAB® software (The Mathworks Inc, Natick, USA). Briefly, each pixel of the crown surface is identified as disclosed plaque or not according to the colour Red Green Blue codes. An interface was also developed to calculate directly dental plaque surface / global tooth surface ratio.

Manual contouring planimetric measure:

Steps 1 and 2 are the same as above.

- Step 3: Manual contouring of the disclosed plaque on crown surface by a trained examiner (FB) using Photoshop® CS4 extended and a graphic tablet (G-Pen M712®).
- Step 4: Calculation of dental plaque surface / global tooth surface ratio.

1.2.2 Validation

Repeatability and reproducibility:

- Repeatability of the manual contouring of crown surfaces, was assessed on 9 teeth (Maxillary I, C, PM3, PM4, M1 and Mandibular C, PM3, PM4, M1) from a single dog by the same naive trained operator on six repetitions.
- Reproducibility study of manual contouring of crown surfaces was performed by two naive trained operators on pictures of 9 teeth from a single dog, with 3 repetitions per operator. T-paired Student test was performed.
- Repeatability study of manual contouring of dental plaque was performed by one trained expert operator on pictures from 9 teeth of a single dog, with six repetitions.
- Repeatability of image–analysis of disclosed plaque measurement was performed by one trained operator on pictures from 9 teeth of a single dog, with six repetitions.

Comparison of methods:

Automatic plaque measurements were compared to manual contouring measures on 63 teeth.

2. RESULTS

2.1 Repeatability and reproducibility evaluations
Average (±SEM) Coefficient of Variation (CV) of crown manual contouring (expressed in pixels), was 1.43±0.28%. No difference was detected between the two operators for the means of crown manual contouring (p=0.13, T-paired Student test).

As expected the 3 repetitions of the automated plaque measure gave the same mean (CV=0%).

Average CV of plaque manual contouring (expressed in pixels) was 2.15±0.72%.

2.2 Comparison of manual plaque contour and automated plaque surface measurements

Dental plaque coverage was measured by manual contour and image analysis on 63 teeth.

Mean (±SEM) coverage differed significantly between image analysis (49.3±2.8%) and manual contour (59.3±3.2%) (p<0.05, paired T-test). The coefficient of correlation between image analysis and manual contouring was 0.90 (Figure 1).

Figure 1: Correlation between manual contouring and image-analysis of plaque surface ratio

![Graph showing correlation between manual contouring and image-analysis of plaque surface ratio.](image1.png)

\[ y = 0.830x \]
\[ R^2 = 0.903 \]
3 DISCUSSION
The objective of this study was to compare an automated measure of dental plaque coverage and its manual assessment by a trained examiner. In this preliminary study, the measurement of the crown surface had to be performed manually because an automated method failed. Our results indicate that our methodology allows a repeatable and reproducible manual measure of the crown surface. The manual delimitation of the plaque coverage was also repeatable.
To validate the image analysis plaque measure, we decided to develop the manual contouring measure based on the assessment of the dental plaque by an expert (as it is the case in the Logan&Boyce index). Secondly, we compared results from the manual contouring measure versus image analysis measures. Based on this study, the correlation between these two techniques was encouraging even though the image analysis tended to underestimate the value compared to the manual contouring.

4 CONCLUSION
The objective of this study was the validation of an image-analysis system for dental plaque coverage assessment in dogs. The new image analysis measure for dental plaque coverage consists of three steps: taking standardized pictures of the maxillary and of the mandibular dental arches of the dogs, manual contouring of the crown surface and image analysis of disclosed plaque on crown surface in order to obtain a ratio plaque surface / tooth surface.

The steps 2 and 3 of the plaque image analysis measure were repeatable and reproducible and showed a good correlation with plaque manual contouring measures.
Before using this new methodology to evaluate the influence of active ingredients on the dental plaque accumulation, the step of taking standardized pictures needs to be validated and the automated plaque surface measurement step improved. Once totally validated, this new methodology of dental plaque assessment will have to be compared with the Logan&Boyce index. With this new methodology development, our final objective is to follow more precisely and accurately the evolution of dental plaque deposition in dogs.

References
Effects Of Ascophyllum Nodosum On Halitosis, Plaque And Gingivitis. A Controlled Clinical Trial In Dogs.

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Introduction
Periodontal diseases (PDs) (i.e. gingivitis, periodontitis) are progressive, inflammatory plaque-induced oral diseases affecting the gingiva and supporting connective tissues and alveolar bone. PDs are regarded as the most frequent clinical problem in small animal practice today (1,2). Halitosis (oral malodour) is one of the most common complaints related to PDs and the first clinical sign referred by the owner (3). It occurs as the result of volatile sulphur compounds (VSCs) overproduction by the oral accumulated anaerobic plaque bacteria. Recently, it has become clear that VSCs, such as hydrogen sulfide and methylmercaptan, hold a pathogenic role in the initiation and progression of oral inflammation (4) and also exert toxic effects on fibroblasts and gingival cells (5,6). Other signs and symptoms of PDs include difficulty or pain in eating, excessive salivation, and several gingival alterations, i.e. loss of normal contour, bleeding, ulcerations and purulent discharge from periodontal pockets (1,7). Generally, the most adequate and suitable conservative options for PDs treatment consists of mechanical removal of plaque and calculus (professional periodontal prophylaxis), in combination with daily maintenance of oral hygiene performed by the owner (8). In particular, the home care regimen mainly provides for daily toothbrushing, the effectiveness of which can be strongly lowered both by the inability to remove the mineralized plaque (calculus) and the poor ownerâ€™s compliance, owing to his inadequate motivation and technical ability or the lack of animalâ€™s cooperation. Ascophyllum Nodosum (AN) is a brown seaweed harvested in the North Atlantic basin, with a high content of fucose-containing sulphated polysaccharides (i.e. fucoidan). These compounds have been shown to interfere with bacterial growth and colonization and calculus deposition (9-11), thus controlling the plaque-related halitosis. The aim of this controlled clinical study is to investigate the effects of a daily long-term administration of an AN-containing supplement [ProDenPlaqueOffAnimal(TM),SwedenCare; Restomy(TM)supplemento in Italy] on halitosis, plaque and clinical signs of gingivitis (bleeding), in dogs who underwent or not professional periodontal prophylaxis.

Materials and Methods
The clinical study was conducted by a research team of Summit Ridge Farms (Susquehanna, Pennsylvania, USA). Sixty Beagle dogs were randomly divided in two groups (n=30), both fed on a standard dry diet throughout the trial (88 days). Before entering the study, one group
underwent professional periodontal prophylaxis under general anesthesia (â€œclean mouthâ€), and the other did not (â€œdirty mouthâ€). Fifteen dogs in each group were daily supplemented with the AN-containing supplement (330 mg/10 kg b.w.) mixed to their food for the whole study duration. The remaining fifteen dogs were used as non treated control group. Halitosis, plaque and gingival bleeding were assessed at the beginning (T0) and the end (T88) of the study. In addition to these primary parameters, the salivary and urinary pH was evaluated at baseline (T0) and after 56 (T56) days of treatment. Furthermore, in order to assess the safety profile of supplement, laboratory tests including complete blood count and serum biochemistry profile have been performed at the beginning and after 56 days. Halitosis was measured by means of Halimeter(TM), an instrument specifically designed to measure VSCs in clinical settings and validated also in the dog (12). The amount of dental plaque and gingival bleeding was visually measured with colorimetric methods (Turesky modification of the Quigley-Hein Plaque Index for plaque (13) and Lobene modified gingival index (14) for gum bleeding). Mean values and standard deviations for the score of each parameter and each assessment time were calculated. Non parametric Z-test was used to determine statistical differences between groups with a P-values < 0.05 considered to be significant.

**Results**

In the â€œdirty mouthâ€ group, the increase in the plaque mean score between T0 and T88 was greater in control dogs (2.1 + 2.58) compared to dogs fed the AN-supplemented diet (0.65 + 2.80). The increase was highly significant in control dogs only (P<0,001) (Figure 1). Likewise, the increase in the oral malodour mean score in the same evaluation period was greater in control dogs (96 + 144.8) compared to dogs fed the AN-supplemented diet (13 + 120.4), and it was significant only in control dogs (P<0,01) (Figure 2). Furthermore, the increase in the gingival bleeding mean score from T0 and T88 was greater in control subjects (0.30 + 1.50) compared to dogs supplemented with the AN-containing diet (0.12 + 0.36) and this increase was significant in control dogs only (P<0,05) (Figure 3). Similar results were recorded in the â€œclean mouthâ€ study group. Referring to salivary pH, the mean values recorded at T56 were significantly lower (P<0,001) compared to T0 values, both in control and AN-treated dogs of both groups. However, the pH drop was greater in control dogs (0.25 + 0.10) than in AN-treated dogs for both dirty- and clean-mouth groups (0.16 + 0.09). On the other hand, in control dogs of both â€œdirtyâ€ and â€œclean mouthâ€ group, the urinary pH mean values recorded at T56 were significantly higher than those recorded at T0 (P<0,001). Finally, no significant differences in serum biochemistry profile and blood count were observed during the study between groups supplemented or not with the AN-containing diet.

**Discussion**

This is the first study to show the beneficial effects of a food supplement containing the brown seaweed Ascophyllum Nodosum (AN) in controlling plaque, halitosis and gingival bleeding scores in dogs. Indeed, the long-term daily administration of the studied supplement was able to slow the increase of halitosis, plaque and gingival inflammation (bleeding) scores during the 88-day study period. Such increase, in fact, was statistically significant limited to the control dogs, i.e. dogs that were not supplemented with AN. These results are consistent
with previous clinical studies, demonstrating the reduction of dental plaque and calculus in human subjects supplemented with high concentration of AN for eight weeks (Wikner S et al, unpublished results). A possible explanation of the effects of AN may rely on the specific biological activities of the brown seaweed active components. There is evidence that these substances (i.e. fucose-containing sulphated polysaccharides, phenolic compounds) are absorbed by the gastrointestinal tract following oral administration, reach the salivary glands through the blood flow and concentrate in the saliva, where they exert a well-known inhibitory effect on bacterial growth and colonization (9-11). Such effect results in the inhibitory control of dental plaque deposition, plaque-related bleeding and halitosis linked to microbial production of VSCs. The results on salivary and urinary pH in dogs treated with AN revealed a buffering capacity of the brown alga. This property is crucial for controlling oral calculus deposition from one side, and, from the other side, preventing pH-related predisposition to struvite stones formation. Finally, the lack of differences in serum biochemistry and blood count between treated and control groups presents a strong evidence in favour of the safety profile of the studied food supplement.

Conclusions

Taken together, the results reported herein provide useful indications for the use of the AN-containing food supplement to perform an easy and high-level daily oral care and control the progression of PDs and their related oral signs and symptoms in the dog.

References

Periodontal Surgery and Guided Tissue Regeneration

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Periodontal surgery is a growing procedure in veterinary medicine. The basic surgical set is similar to traditional oral surgery; however flap design is often different.

This lecture will initiate with the basics of periodontal surgery including indications, equipment needs, and flap design.

Following this will be an in depth presentation on the various membranes and bone regeneration currently available. We will discuss the pros and cons and relative effectiveness of the currently available products. This information will be a combination of literature search and personal experience.
General anaesthesia in dental patients

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Introduction

Good dentistry for animals can’t be performed without general dentistry. The animals that are treated for dentistry are predominately older animals. This means that safe anaesthesia is even more important. Dental patients are often worked on by technicians without a veterinarian monitoring the patient. When working in the mouth we usually use a lot of water, the animals lie on a cold and very often wet table because of this hypothermia and its associated side effects this poses a great risk.

In veterinary anaesthesia the ASA system is still widely used for classifying the veterinary patients.

The ASA physical status classification system is a system for assessing the fitness of patients before surgery. In 1963 the American Society of Anesthesiologist (ASA) adopted the five-category physical status classification system. These are:

1. A normal healthy patient.
2. A patient with mild systemic disease.
3. A patient with severe systemic disease.
4. A patient with severe systemic disease that is a constant threat to life.
5. A moribund patient who is not expected to survive without the operation.

There have been several studies with regard to anaesthesia related deaths in veterinary medicine.

Some results:

**Cardiovascular causes:**

Between 30 and 70% of deaths resulted from relative anaesthetic overdose and myocardial depression, cardiac arrhythmias or circulatory failure and hypovolaemia.

High-risk patients were the most likely patients to die from circulatory failure, as they were often hypovolaemic prior to anaesthesia.

**Respiratory complications:**

Represent the other main cause of anaesthetic-related deaths, they were an underlying cause of death in 30-40% of dogs and about 40-50% of cats. Problems with airway maintenance and

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1,2,3,4,5,6,p31

ii,6,p29
inadequacy of ventilation represent the principal factors resulting in death. Failed intubation, trauma to the upper airway, inadequate ventilation and delivery of a hypoxic inspired gas mixture have all been documented.\textsuperscript{1,2,3,6,31}

Old patients may be more susceptible to the depressant effects of anesthetics, to hypothermia via impaired thermoregulatory mechanisms and to prolonged recoveries due to tendencies to reduced metabolic functions and hypothermia.\textsuperscript{4}

Dave Brodbelt did a nested cohort study between June 2002 and June 2004. One hundred and seventeen centres participated in that study. 98,036 dogs, 79,178 cats and 8,209 rabbits were anaesthetized or sedated and 163, 189 and 114 anaesthetic related deaths were identified respectively.\textsuperscript{6,2}

**Results of the Brodbelt study**

Major procedure patients are 3 times more likely to die than minor procedure patients, this consistent with dogs, cats and rabbits in this study.\textsuperscript{6,213}

The majority of these anesthetic-related deaths occurred post operatively, 50% occurred within 3 hours of termination of anaesthesia.\textsuperscript{6,224}

Halothane was associated with a 5-fold increase in odds compared to isoflurane.\textsuperscript{6,226}

Preoperative blood testing, particularly in the most sick patients (ASA 4-5) was associated with reduced odds.

**Cats:**

Cats of 12 years and older are 2.1 times more likely to die than young cats.

Patient weight was also associated with anaesthetic related death, with patients under 2 kg being nearly 16 times more likely to die and larger patients (6 kg or more) nearly 3 times more likely to die than 2-6 kg patients.\textsuperscript{6,213} The four-fold increase in odds associated with receiving fluid therapy was surprising. This has not been reported before in animals, was counter-intuitive, and may reflect residual confounding, particularly by health status, age, procedure type, and duration.\textsuperscript{8,621}

Apparently healthy cats (ASA 1-2) had a two fold higher risk of death than healthy dogs, but at least 7% of apparently healthy cats have an undetected cardiac disease. Cats are reported to be prone to postoperative renal failure.\textsuperscript{6,105}

**Dogs:**

In brachycephalic dogs respiratory obstruction was the principal cause of respiratory complications.\textsuperscript{7} Pekingese were the most common breed to die.\textsuperscript{2}

Dogs of 12 years and older are approximately 10 times more likely to die of anaesthetic-related causes than younger dogs.\textsuperscript{6,166} Patient weight was also associated with anaesthetic-related death, with patients under 5 kg being 7 times more likely to die.\textsuperscript{6,167}

Increasing
intended duration of anaesthesia was another important factor with odds increasing 1.06 times for each ten-minute increase in intended duration.\textsuperscript{6,p.168}

**Discussion**

Our dental patients are often in the above-mentioned categories. Combined with the tendency towards hypothermia because of all the water and cold wet tables that we frequently use in veterinary dentistry we can conclude that the dental patients are in the high-risk category. In order to give our dental patients the safest possible anaesthesia we need to perform a critical risk assessment.

**Charting**

It is necessary to chart all the parameters that are monitored during the anaesthesia. Complications should be noted so that adjustments can be made for future anaesthetic protocols. Advantage; makes you control the monitor at determined times

**Monitoring;**

Monitoring pulse and the use of pulse oximetry were associated with reduced odds.\textsuperscript{6,p.214}

Theoretical analysis in human anaesthesia suggested pulse oximetry alone would have detected 40-82\% of reported perioperative incidents, combined with capnography 88-93\% and combined with blood pressure 93\% of the incidents. The use of heart rate monitors was associated with increased risk of morbid complications. These monitors provide a false sense of security because they provide only a heart rate and no indication of pulse quality.\textsuperscript{6,p.50} The easiest and most important parameter to monitor and the first preferred by this author is the body temperature. Hypothermia is a major risk factor in veterinary dentistry. The second monitor preferred by this author is the capnograph; there are two types of capnography; mainstream and sidestream capnography. In mainstream capnography the adaptor attaches to the endotracheal tube and the PCO\textsubscript{2} is measured directly. In sidestream capnography the adaptor attaches to the endotracheal tube as well and small amounts of airway gas are sampled to determine the PCO\textsubscript{2}. This author concluded that the mainstream adaptor is very sensitive towards moisture and that the sidestream capnograph is to be preferred. The main advantage of capnography is that it is the earliest indicator of decline in cardiac function.

The third parameter this author recommends to monitor is blood pressure. This author recommends the use of Doppler equipment, because the Doppler produces the sound of the heart beating it necessary to use equipment that produces enough sound for the staff to be able to hear it whilst performing other tasks. Keeping this sound on during anaesthesia is very reliable, in contrast to several combined machines that produce so many false alarms that veterinarians tend to turn the sound of and then again a false sense of security is created. Doppler blood pressure measurement uses a small piezoelectric crystal placed over an artery. A mean arterial blood pressure above 60 to 70 mm Hg is necessary to ensure adequate tissue perfusion. Air is pumped into a cuff, occluding the artery until the probe is no longer...
detectable by the Doppler probe. As the pressure in the cuff is release, blood again begins to flow through the artery. Systolic pressure is determined when flow is first heard or the needle on the gauge oscillates.\textsuperscript{10, p.614} ECG is the last monitor to have although it is valuable for hart rhythm and AV blocks, the ECG by itself can give a false sense of security, electrical complexes can still be observed without mechanical activity of the hearth.\textsuperscript{10, p.615-619}

The pulse oximeter; is more difficult to connect in the dental patients. The sensor can be attached to the ear, prepuce, or an oesophageal sensor can be used. The pulse oximeter will not detect apnoea before it is too late, anaemic patients may have normal pulse oximetry, despite inadequate delivery of oxygen to the tissues.\textsuperscript{12, p.145}

**Preanaesthetic diagnostics:**

Haematological and biochemical abnormalities may also be significant. In particular anaemia will reduce oxygen carrying capacity and predispose to hypoxia, whilst hypoproteinaemia may increase the sensitivity of the patient to highly protein bound drugs, and result in relative overdose. Renal disease is also important, particularly if dehydration or uraemia is present, under these conditions the kidneys will have a lower intolerance to anaesthesia and the patient will be more sensitive to anaesthetics given. After hypotensive anaesthesia, chronic renal failure may be converted to acute disease.\textsuperscript{6 p. 46} \textsuperscript{T4 TEST; Hyperthyroidism in cats and hypothyroidism in dogs are the most prevalent chronic hormonal disorders in these species. It is recommended to make the T4 test part of the preanesthetic diagnostics.}

**Anaesthetic agents:**

Acepromazine, Dosage 0.02-0.05 mg/kg SC or IM, causes vasodilatation and hypotension with minimal direct cardiac or respiratory depression. It increases the threshold to catecholamine-induced arrhythmias.\textsuperscript{6, p.49} Inhibits thermoregulation\textsuperscript{9, and p.2}. Can be used in neuroleptanalgesia. This author recommends its use only in ASA 1 and 2 patients.

\(\alpha_2\) agonists:

Medetomidine and Dexmedetomidine, Dosage dog, 1 to 40 \(\mu\)g/kg IM; cat 5 to 40 \(\mu\)g/kg IM, \(\alpha_2\) agonist, advantages; profound analgesia, bradycardia as a physiologic response, MAC (minimal alveolar concentration) sparing effect, antagonist (atipamezole) is available, disadvantages; peripheral vasoconstriction results into cyanosis, second degree AV block may occur, increased risk of arrhythmias with catecholamine’s (excitement, stress) and with inhalation agents. To be used only in ASA1-(2 with care) patients.\textsuperscript{9, p.68}

Benzodiazepines:

Cause excitement in cats when used alone, give sedation and tranquillization, add to opiate (analgesic) to produce neuroleptanalgesia. Diazepam; Dosage 0.2 mg/kg IV (not well absorbed IM, fat soluble), midazolam (water soluble) can be used IM as well, advantage; decreases the dosage of propofol, or etomidate, disadvantage; careful with renal, hepatic or debilitated patients\textsuperscript{9, p.17, 74}
Dissociative anaesthesia:

Ketamine, produces a cataleptic state, advantage; produces strong somatic analgesia, restrains aggressive cats disadvantage; hypersalivation, muscle tone, cardiac output, pulmonary artery pressure, central venous pressure and intraocular pressure are all increased. MLK (morfine/methadone 10 mg + lidocaine 150 mg + ketamine 30 mg in 500 ml lactated Ringer’s solution) safest way to use ketamine

Opioids:

Buprenorphine, Dosage 0.01-0.02 mg/kg, advantages; minimal respiratory depression, last 2 to10 hr, can be used sublingually in cats, disadvantages; partial µ receptor agonist is difficult to reverse, provides moderate analgesia, onset time is 20-30 minutes IV, 30-45 minutes IM. Butorphanol, Dosage 0,1-0,2 mg/kg, a mixed agonist-antagonist, advantages; has a sedative effect, no histamine release when given IV, minimal cardiovascular depression, rapid onset (3 min. IV, 20 min. IM) disadvantages; only mild pain relief, duration only 2-3 hours Morfine (slowly IV) and methadone (IV or IM), Dosage dog 0.5- 1 mg/kg, cat 0,1-0.5 mg/kg, advantages produce greater pain relief and sedation, methadone (no histamine release) produces significantly less vomiting than morfine (histamine release), can be reversed with naloxone, disadvantage; not to be used in debilitated patients Fentanyl, suffentanyl, can give severe respiratory depression, to be used by referral centres with ventilation support available. Fentanyl transdermal patch, Can be used as postoperative analgesia

**Induction Drugs:**

Propofol, Dosage given to effect. Advantages; short duration of anaesthesia, can be given repeatedly in dogs because of minimal accumulation, disadvantages; respiratory depression (preoxygenation recommended), can’t be repeated in cats because of prolonged recoveries

Etomidate; dosage 1-3 mg/kg IV, advantages, minimal CV side effects in dogs, disadvantages; expensive, does have CV side effects in cats

**Inhalant anaesthetic agents:**

Halothane, not to be used anymore, has severe side effects compared to isoflurane

Isoflurane, advantages, minimal hepatic metabolism, chamber induction possible, disadvantages; hypotension at high concentrations, pungent odor, CV and respiratory depression (dose dependant)

Sevoflurane: advantages, more rapid induction and recovery, no odor, disadvantages; less potent than isoflurane, more expensive

**Body temperature maintenance:**
Hypothermia is a common side effect during anaesthesia. The body loses warmth because of vasodilatation, inspiration of cold gasses, cold tables, wet surfaces, evaporation of the wet skin and mouth, and prolonged anaesthesia time\textsuperscript{13} p. 280.

This author recommends the use of circulating warm water heating pads in combination with forced warm air blowers. Constant monitoring of the temperature remains necessary to prevent both hypothermia and malignant hyperthermia.

Conclusions

General anaesthesia can be performed in an overall safe way in dental patients. The use of a tube in combination with inhalation anaesthesia is mandatory to prevent the dental patient from swallowing, or aspirating all the fluids and chemicals that are used during a dental procedure. If only fluid anaesthesia is administrated, the use of a tube is still recommended. It is advisable to combine this with a small cotton cloth in the back of the mouth to prevent the debris and fluids from accumulating there, this cloth should be replaced frequently. All anaesthetic fluids and gases are potentially toxic, the aim of the veterinarian performing anaesthesia should be to keep the level anaesthesia as low as possible and at the same time maintain a pain free and adequate hypnosis.

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Local anesthesia: anatomy, equipment, procedures

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Local anesthesia is a relatively simple way to achieve adequate pain control and to reduce the general anesthetic level. However, basic anatomic understanding of the skeletal landmarks and the location of the foramen are essential.

Equipment

The only necessary equipment is a tuberculin syringe with a 27 gauge 1-1.5-inch needle. This can be refined by using a dental anesthetic syringe with a 1.5-inch 27 gauge needle, designed to work with anesthetic carpules.

Local Anesthetic Agents

Although there are many agents available, a 50-50 mixture of Bupivacaine 0.5% (long acting) and Lidocaine 2% (short acting) is preferred.

Lidocaine 2% has a short onset time of a few minutes but only lasts between 30 minutes and two hours (can be increased by up to 50% by adding epinephrine, but the use of epinephrine is contraindicated in patients with uncontrolled hyperthyroidism, cardiac dysrhythmias, and asthma).

Bupivacaine 0.5% has a longer onset time (approximately 30 minutes) but lasts 2.5-6 hours. Great care has to be taken when using Bupivacaine in cats as even a very small amount can be fatal if inadvertently given IV.

The maximum dose of Bupivacaine is 2 mg/kg; this is 0.4 ml/kg in total for dogs and cats. The maximum dose of lidocaine is 5 mg/kg for dogs and 1 mg/kg for cats. If using the 50-50 mixture, it is recommended to reduce the maximum dose by 50%.

The recommended maximum dose in cats is 0.25 ml per site and in dogs is 1 ml per site. An easily rule of thumb is to keep the total body dose under 2 mg/kg BW, regardless of the agent being utilized. In small patients, it may be safest to draw up the total calculated body dose at the beginning of the procedure and label it with the patient’s name. The agents come in 1.8 cc carpules, or in larger bottles for multiple use.
Regional Blocks

Whereas local blocks are most commonly used in human medicine, regional blocks are typically used veterinary medicine. Regional blocks provide anesthesia to the associated teeth and soft tissues after being injected in the foramen.

Local Blocks

Local blocks are performed by injecting the agent into the periodontal space or gingiva. This method is technically easier, but only provides anesthesia to the local soft tissue.

Intraosseous Blocks

Regional anesthesia can also be achieved by injecting the anesthetic agent directly into the bone. Although this is a safe method and requires only low doses of anesthetic, it is not the recommended technique for a novice.

Technique - regional nerve blocks

There are two important points to remember while performing regional anesthesia:

1. Aspirate before injecting (to avoid iv administration of the agent)
2. Hold pressure over the foramen with the index finger (to aid in diffusion of the agent)

Mandibular nerve blocks:

Mental

The mental nerve block affects the tissues rostral to the second premolar on the injected side. The middle mental foramen is the largest of the three and is therefore the preferred injection site. The foramen can be palpated in medium to large breed dogs, and is ventral to the mesial root of the second premolar. In cats and small breed dogs, the mandibular labial frenulum can be used as a landmark.

Inferior alveolar

The inferior alveolar (mandibular) nerve block anesthetizes all teeth, bone, and soft tissue in the mandible on the injected side. The foramen is located on the lingual surface of the mandibular bone. In the dog, the foramen may be palpated at two-thirds the distance between M3 and the angular process. In the cat, the foramen may be palpated halfway between M1 and the angular process. The foramen can be approached either intraorally or extraorally.
Maxillary (Infraorbital) nerve blocks:

**Rostral maxillary**

The rostral maxillary block anesthetizes the maxillary teeth as well as associated bone and soft tissue from I1 – PM2 on the injected side.

The foramen can be palpated just apical to the distal root of the maxillary third premolar.

The needle is inserted into the foramen while holding the syringe parallel to the palate in a rostro-caudal direction. Depending on the size of the animal, the needle is inserted 3-10 mm.

**Maxillary (by orbital approach)**

The entire ipsilateral maxillary (and pre-maxillary) bone as well as the associated teeth and soft tissues are anesthetized. Rather than using the caudal maxillary block, this author recommends the orbital approach. It is relatively easy, and with proper technique there is minimal risk of causing ocular damage. The index finger is placed on the lower eyelid, and the most rostral part of zygomatic arch is palpated. The needle is inserted in a dorsoventral direction through the skin until the bottom of orbital space is reached.

Always take a laboratory class before trying local anesthesia on a live animal.

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Oral radiography: the diagnostic tool. Part I

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Oral radiography is an important diagnostic tool that can validate the findings of the initial oral exam and lend support to a logical treatment regimen. In order for practitioners to maximize its capabilities they first must understand normal oral anatomical structures as they relate to their normal radiographic findings. To this end, we will first correlate the normal anatomy of the tooth, gingiva and jaw to their radiographic images. Next we will discuss pathological deviations as seen on oral inspection with their radiographic findings. Finally we will review over the basic equipment, materials and techniques of oral radiology and tips to help us interpret what we have imaged.

The tooth anatomically is divided into a supragingival crown and a subgingival root. The crowns of all like teeth i.e. incisors, canines premolars and molars should be equal in size and form and in the same position in the dental arches as their contralateral side. They are covered by enamel which is 98% inorganic hydroxyapatite crystal that is roughly 1.5 mm thick and incapable of repair. Visually enamel is white and smooth. Radiographically enamel is a thin dense white line covering the crowns surface and ending either at or slightly below the gingiva.

Enamel pathology can cause changes in the chemical composition, form and color of enamel. Enamel dysplasia or hypoplasia, enamel attrition and abrasion, bacterial caries, and resorptive lesions can have different clinical and radiographic signs. Clinically In the first two entities, multiple teeth are mottled and stained. The abnormal enamel layer is frosty in appearance and chips easily. The dental films show a superficial demineralization or a loss of density of the enamel layer on multiple spots on the crowns. The underlying dentin is not affected. In comparison, with enamel attrition or abrasion, the enamel has been traumatically damaged but the surrounding surface is normal and hard. The dentin might also show changes and radiographs show a void of dental substance. With this trauma often the teeth can become devitalized. Radiographic evidence of concurrent endodontic disease is often visible. In contrary to enamel dysplasia, caries and resorptive lesions show radiographic demineralization of deeper layers. They often only affect solitary teeth. On clinical probing of caries the brown decay is soft and usually is seen on flat occlusal surfaces like the upper molars. With resorptive lesions the surrounding gingiva often grows into the side of the tooth. The diagnostic images of resorption often show root dissolution of the dentin and its replacement by a bone like material.

Dentin which is the bulk of the tooth internally is 20% organic collagen and 80% inorganic hydroxyapatite. It is denser then bone and is laid down in microscopic tubules. Dentin is laid down continuously throughout the life of the tooth by odontoblasts which line the pulp chamber and root canal. As the tooth matures the dentin becomes thicker and the root canal and pulp chamber becomes narrower. A young tooth therefore has a very large root system. This fact is important in the determination of a toothâ€™s age and vitality. Radiographically all teeth that are in the same living stage of development should have canal
diameters that are proportionate to the size of the tooth in question and be equal to the same contralateral tooth. For example in the healthy state, the root canals of the canines are equal to each other but larger than the canals of the incisors. This fact is important in determining not only age but health. A tooth that dies will be arrested in its internal growth and the canal diameter will be larger. Normal radiographic dentin has a homogenous density. It is denser than the surrounding bone.

In addition to the aforementioned pathology, any changes in color of dentin might indicate an underlying disease state. Pink and grey discolorations are caused by tooth trauma and irreversible pulpititis. The inflammation of the pulp leads to internal pressure and subsequent pulpal necrosis and devitalization. Radiographically a dead tooth internally can show irregular resorption of dentin and periapical granulomas. In contrary, yellow discoloration of the deciduous and adult teeth’s enamel and dentin is often caused by administration of tetracycline and its derivatives to the prepartum bitch and post partum young animals to the age of 6 months. These teeth on radiographs appear clinically normal.

The subgingival root is covered by cementum a type of bone. The periodontal ligaments which anchor into it, fix the tooth to the lamina dura of the alveolar bone. The crestal alveolar bone is within 2 mm of the cemental enamel juncture. Radiographically the periodontal space which contains the elastic and collagen fibers of the ligament should be a uniform black line all the ways around the root. The lamina dura is a denser white in comparison to the rest of the alveolar bone.

Radiographic pathology of the above periodontal structures (gingiva, ligament, cementum or alveolar bone) is seen as horizontal or vertical bone loss. This can be seen around the roots when the level of bone height falls below 2 mm from the cemental enamel junction. Often there is an irregularity of the bone height or loss of the walls surrounding the tooth. This leads to intrabony pocketing. The lamina dura becomes less dense. The periodontal space can become irregular.

The incisors, canines 1st premolars and 3rd lower molars all have one root. The upper 4th premolar (carnassial) 1st and 2nd upper molars have three roots. All the rest of the premolars and lower molars have two roots. Quite often roots can be abnormal in both number and structure. Not uncommon are supernumerary roots of the lower premolars. Fusion of multiple roots can often be radiographically visible. These abnormalities usually do not have any consequences. In contrary, abnormal curvature of the roots secondary to partial impactions can often lead to devitalization of the tooth. This is evidenced by bone lysis around the apices of multirooted teeth.

On physical exam any missing teeth should be noted. In a young animal this can either be a sign of genetic absence often an inherited problem or impaction of either the deciduous or adult teeth. In most breeds eruption of the primary teeth is finished by 4 weeks and the secondary teeth by 6 months. Like teeth have coordinated eruptions. For example, the two central incisors should be in before the intermediates or the laterals start erupting. The first adult premolars which have no deciduous counterparts erupt before all the other premolars. Any dyssyncrony of eruption needs radiographic verification to determine if it is a case of Oligodontia (genetic absence) versus impaction. In the latter situation either partial or complete eruption problems can lead to the development of dentigerous cysts. These are space occupying lesions which destroy the surrounding bone. These are expansile lesions which
appear around affected teeth roots or crowns. The area of bone lysis is well defined by
cortication. Often the relative number of teeth can be affected by trauma in which the crowns
of the teeth have been fractured off and the gingiva overgrows the roots. If this is an acute
injury with a healthy tooth, the body often does not react to the remaining root tip. If the
fracturing of the crown and root occurs as a sequella of bad extraction technique of a diseased
tooth, significant bone lysis around the infected root occurs and secondary fistulization. A
variation of this can be seen with Feline odontoclastic resorptive lesions (FORL). Radiographic
confirmation is imperative since if the root is present but not quiescent there
will be evidence of alveolar lysis surrounding the persistent root.

The gingiva and underlying jaw bone needs to be assessed for any swelling or lack of
symmetry. Neoplastic, inflammatory, and developmental diseases must be included in the
primary differential diagnosis. Associated signs of purulence, dependent edema, fluctuence of
underlying tissue and epistaxis need to be radiographed. The presence of unilocular (one
radiolucent space) corticated (radiopaque rim) often indicates slow growing benign lesions
like periapical granulomas or dentigerous cysts. Non corticated fuzzy or ill defined borders
can indicate osteomyelitis or neoplasia. Particular attention to the lesions location in reference
to dental elements should be noted. The presence of lytic lesions periapically (around the
tooth apex) could indicate a non-vital tooth. These cause periapical cysts or abscesses.
Pericoronal lysis (around the crown of unerupted teeth) is commonly seen in dentigerous cysts
or calcifying epithelial odontogenic tumors. Swelling of the nasal dorsum or involving the
soft or hard palate require nasal and maxillary sinus radiographic evaluation. Unilateral
destruction of the turbinates or the nasal septum indicates an aggressive lesion.

Any acute malocclusion of the teeth of the upper and lower jaw needs to be
radiographically evaluated. Avulsed teeth, fractures of the mandible or maxilla, or luxations
of the TMJ can lead to teeth that are traumatically misaligned. If partial tooth avulsions are
present, examine the image for any tooth elements that might still be within the alveolus. Also
check to see that the tooth root is closed as evidenced by apexification (closure of the apex) of
the root. These factors are important in the therapeutic success Always compare the
contralateral side to highlight unilateral or bilateral pathology. In fractures note if there are
any tooth elements which are contained in the fracture site. Roots within the fracture line will
destabilize the bone healing. Evidence of severe comminution and fracture distraction
radiographically will create a therapeutic healing challenge. Localization of fractures
secondary to gun shot wounds and secondary infection of the tissue often lead to jaw
resections versus bone stabilization.

In cranio-dorsal TMJ luxations, the jaw lateralizes to the side opposite the luxation i.e.
a luxation of the left TMJ causes the mandible to deviate to the right side. Ventral dorsal
imaging is helpful to compare bilaterally where the condyle sits in the fossa. It also allows
complete visualization of the mandibular rami. Lateral oblique projections will differentiate
dorsal versus ventral luxations. Contrary to the fore mentioned TMJ luxations are fractures of
the condyle or TMJ fossa. Clinically these present with lateralization to the ipsilateral side as
the lesion. Again with the above imaging technique this can be ascertained.
Dental Radiology: The Equipment And Technique Involved With Getting The Image. Part II

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The need to accurately document oral health and its disease states, in conjunction with the thorough oral examination, requires proper technique using a dental x-ray unit and intra-oral film.

Indications for oral radiography are the following:
* Periodontal exam shows > 3mm gingival sulcus
* Detection of absent teeth
* Oral exam leads to suspicion of endodontic and it’s associated periapical disease
* Oral exam leads to suspicion of jaw fractures, broken teeth or fistula evaluation
* Evaluation of soft and hard tissue swelling
* Evaluation of the root system in either a fractured tooth or one with an abnormal crown.
* Evaluation of Root Canal Therapy with pre, intra,& postop. Radiographs
* Determination of neoplastic bony involvement
* Maxillary and nasal sinus evaluation

Most dental machines are 10-12.5 Milliampere-seconds (mAs) with between 60-90 (kVp) penetration capability. They have a focal film distance of 12 inches and focal spots of between 0.3 to 1.5mm. The last two parameters together yield an increased dental detail (less blur, less enlargement and less distortion). Couple the above capabilities with the fact that the dental unit is small, maneuverable, and often has diminished scatter due to lead lined cylinder cones and near parallel rays, this type of x-ray machine gives the practitioner an excellent and convenient diagnostic tool in their assessment of oral structures.

Intraoral film is small, flexible and unscreened which when inserted intra-orally, permits isolation of one or more teeth and gives exceptional detail. It contains within its plastic cover a sheet of lead foil behind the film which reduces the backscatter radiation from deeper lying tissue. By isolating individual teeth from adjacent tissue, any superimposition of their image on the film is avoided and therefore interpretation is made easier. Each film packet is marked by a "raised point" on one of the corners. This can be seen throughout all the layers in the film packet and should always be facing the x-ray tube when exposures are done since it always places the lead behind the film. By orientating this raised dot on the film towards the front of the animal, the practitioner will know whether the right or left dental arch was taken when viewing the developed film. On interpretation, the film dot should face up and therefore when viewing the animal's right side; the molar teeth will be on the far left side of the film whereas when viewing the left dental arches, the more caudal cheek teeth will be depicted on the films far right.

The speed of dental film most commonly used by the Veterinary Dentist is the Ultraspeed, since it gives the finest detail. Ektaspeed, although twice as fast and therefore
requiring 1/2 the exposure time, is grainier and has as it's primary usage in giant breeds with large teeth that necessitate greater penetration without increasing the exposure time. The Ultraspeed film sizes most often used are the periapical film #0 or DF54 (cats and toy breeds), #2 or DF58 (small-large breeds) and #4 or DF50 which is a 2 1/4" X 3" occlusal film. Dental film is usually packaged either singly or with two films per packet. The additional film allows you to give the copy either to the referring Veterinarian or owner.

Since most dental units are 10mA/70kVp with a focal film distance of 12 inches when the end of the tube head cylinder touches the patientâ€™s face, the only setting the practitioner must adjust is the exposure time.

For the small to medium case load dental practice, a "chairside darkroom" allows a very cost effective, space constrained ability to quickly develop one's dental films. This 14"W X 8"H X 7" opaque plastic container with an amber safety Plexiglas viewing top, allows the technician by inserting their hands through the side rubber diaphragms, to develop films in the four 6-ounce cups. Two of which contain water rinses and a cup each for developer and fixative solutions. The rapid chemicals that have been developed for this system allow visualization of the films in less than a minute. It is important to thoroughly rinse before, during, and after the developer and fixative stages in order to get films of good archival quality and which don't turn brown over time. In order to insure the highest quality film documentation, proper exposure and development of the films are necessary.

**Technique In Oral Radiology**

Intra-oral radiography comprises two specific techniques in order to capture accurately on film the tooth and the periapical tissue. The Parallel technique can be used for the teeth of the posterior mandible or a nasal study. Both areas allow for the radiographic film to be placed in such a manner, that it's plane lies parallel to the plane of tissue being studied i.e. (long axis of tooth or nasal chamber) The x-ray beam therefore will strike the film plane perpendicular and create a non distorted image. This method has limited applicability for imaging due to the fact that most of the animalâ€™s teeth do not lend themselves to parallel film placement. The shallow, flat palatal vault and the shallow sublingual vestibule make it impossible for the above technique to adequately capture the upper arch teeth or Canines.

In utilizing the Bisecting Angle technique, the film is placed against the tooth with the crown as close to the film border as possible. This allows adequate film exposure for the tooth's radicular and periapical area, in case of any error in angulation. An imaginary plane is drawn which bisects the angle created by the film plane and the tooth to be x-rayed. The x-ray beam should be directed perpendicular to this imaginary plane of bisection.

There are six basic views which will complete a dental survey:
1) Rostral maxillary occlusal view (upper incisors and cuspids)
2) Rostral mandibular occlusal view (lower incisors and cuspids.
3) & 4) Left and right maxillary oblique view (upper cheek teeth)
5) & 6) Left and right mandibular oblique view (lower cheek teeth)

In the above radiographic projections, in order to separate the two mesial roots of the maxillary carnassial tooth and prevent superimposition, the directing of the x-ray beam 30 degrees in a rostro-caudal or caudal rostral direction will accomplish this
visualization. The bisecting angle technique is maintained in order to achieve the proper tooth-image relationship.

Tips on Interpretation of the Films
1) Mount and orient the radiographs according to the appropriate quadrant: Right & Left Upper and Lower
2) Identify all the teeth and their type and their respective roots. Check for comparable root lengths with the same tooth on the contralateral side. Also make sure that the teeth are in similar stages of development (This is important to determine tooth death) Check for retained roots, open apices and missing teeth. Check the density of dentin in the crown and root.
3) Follow tooth outline and check periodontal ligament space for uniformity. Is it to wide, narrow or is the tooth ankylosed with the bone?
4) Is the periapical area of the root of uniform bone density? Are there any abnormal contours of the root?
5) Check the inter alveolar bone crest level, it should be within 1-2 mm of cementoenamel junction of the tooth. Is their horizontal or vertical pocket bone loss?
6) Is the trabecular bone density pattern uniform at root furcation?
7) Make sure that any suspicious lesions are not normal anatomy i.e. perfectly round lytic lesion of bone often are nutrient foramen.

Remember Radiography like any tool requires practice and if there is ever a doubt shoot a second film. Always compare to the opposite side. If necessary shoot a different angle of the same tooth. These films will be your documentation of the disease present and your efforts at treatment.

References:
Oral Pathology

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Persistent deciduous teeth:

Persistent deciduous teeth are very common, especially in small and toy breed dogs, however, they can occur in any breed as well as in cats. Previously, it used to be believed that the persistent deciduous tooth caused the permanent tooth to become maloccluded. Studies have shown however, that it is the actually the permanent tooth erupting incorrectly that causes the deciduous tooth to persist.

These persistent teeth create both orthodontic and periodontal problems if not treated promptly. Reports have shown that orthodontic problems begin within two weeks of the permanent canines starting to erupt. This is due to the deciduous tooth being in the place that the adult wishes to occupy. Periodontal issues occur as a result of persistent deciduous teeth due to a disruption of the normal maturation of the periodontium. If a persistent deciduous tooth is present, it obstructs one area of the periodontium from attaching to the permanent tooth, and therefore the periodontal attachment of the permanent tooth will not be normal. Reports have shown that this damage begins within 48 hours of the permanent teeth starting to erupt!3

Ergo, the adult tooth need not be completely erupted for these problems to occur. Therefore, once permanent teeth have begun eruption, the persistent deciduous tooth should be extracted as early as possible. It is important not to delay this procedure until six months of age in order to perform the extractions along with a spay/neuter surgery.5 In fact, it is best to instruct the owners of breeds which are prone to persistent deciduous teeth to watch for eruption of the permanent teeth and to pursue therapy as soon as this occurs.

Fractured teeth:

Crown fracture in veterinary medicine can be basically classified as complicated or uncomplicated. Complicated crown fractures have direct pulp exposure, whereas uncomplicated crown fractures have direct dentinal but not pulp exposure. Both types of fracture require therapy, however treatments are often different.

Uncomplicated crown fractures are a very common finding on oral exam, particularly in large breed dogs (Figure 1). These fractures result in direct dentinal exposure, and exposed dentinal tubules create significant pain (or sensitivity) for the patient. The currently accepted means by which this sensitivity is created is via the theory of fluid dynamics. In addition, some of these teeth become non-vital due to the traumatic incident, pulpal inflammation, or direct pulpal invasion via the dentinal tubules. Therefore, it is recommended that these
teeth be radiographed to ensure vitality. If the teeth are non-vital (evidenced by periapical rarefaction or a widened root canal endodontic or exodontic therapy is required. If the teeth appear vital, the application of a bonded composite is recommended to decrease sensitivity.

All teeth with direct pulp exposure (complicated crown fractures) (Figure 3) should be treated with endodontic or exodontic therapy; ignoring them is NOT an option. Prior to tooth necrosis, the viable nerve is excruciatingly painful. Following tooth death, the root canal system acts as a bacterial super-highway creating not only local infection, but also a bacteremia. Bacteremias have been linked to more serious systemic diseases. Owners of these patients are often reluctant to pursue therapy because they believe “it does not seem to bother the dog”. However, fractured and/or infected teeth do affect animals creating pain, infection, fatigue, etc., but often these signs are subtle or hidden. In fact, most owners see a noticeable or even dramatic improvement in their pet’s attitude and energy level after therapy is provided.

**Intrinsically stained teeth (Figure 2):** Intrinsic staining is another clinical sign of tooth death and (possible) secondary infection. Affected teeth can appear as pink, purple, yellow, or grey. A study by Hale showed that while only 40% of intrinsically stained teeth had radiographic signs of endodontic disease, 92.7% of these teeth are actually non-vital. Non-vital teeth lose their natural defence ability and are often subsequently infected via the bloodstream, which is known as anachorisis. Therefore, it is important that practitioners do not rely on radiographic appearance to determine vitality. All intrinsically stained teeth should be definitively treated via root canal therapy or extraction.

**Feline Tooth Resorption (TRs) (Previously known as resorptive lesions):** TRs are a very common problem. Reports vary as to their incidence from 30 to 60% of cats being affected. The main risk factors are increasing age and the presence of other dental disease (including additional TR lesions). TRs are caused by odontoclasts, which are cells that are responsible for the normal remodelling of tooth structure. These cells are activated and then do not down-regulate, resulting in tooth destruction.

There are currently two recognized forms of resorptive lesions, type 1 and type 2. Clinically they appear very similar, as dental defects that are first noted at the gingival margin. However, advanced cases show significant tooth destruction and actually look like a fractured tooth. Dental radiology is the best diagnostic tool for differentiating the types of TRs. With type 1 lesions, there is no replacement of the lost root structure by bone, whereas with type 2 there is generally marked replacement of the lost tooth structure.

Type 1 TRs are typically associated with inflammation such as caudal stomatitis or periodontal disease. In these cases, it is thought that the soft tissue inflammation may have activated the odontoclasts. The weakened crown will eventually fracture, while the root canal system stays intact resulting in continued pain and infection for the patient.
Historically, restoration was a recommended therapy, especially of early lesions. However due to the progressive nature of the disease; this carries a poor long term prognosis and is rarely performed today. Therefore, extraction is now the treatment of choice. Extractions can be very difficult in these cases due to tooth weakenening and ankylosis. In cases with significant weakening and or ankylosis, performing the extractions via a surgical approach is recommended.

Recently, crown amputation has been suggested as an acceptable treatment option for advanced type 2 lesions as it results in significantly less trauma and faster healing than complete extraction. This procedure, although widely accepted, is still controversial. Veterinary dentists typically employ this treatment option only when there is significant or complete root replacement by bone. In contrast, the majority of general practitioners use this technique far too often. Crown amputation should only be performed on teeth with radiographically confirmed advanced type 2 TRs which show no peri-apical or periodontal bone loss. Crown amputation should not be performed on teeth with type 1 TRs, radiographic or clinical evidence of endodontic or periodontal pathology, associated inflammation or infection, or in patients with caudal stomatitis. Practitioners without dental radiology capability SHOULD NOT perform crown amputation. In these cases, the teeth should either be fully extracted or the patient referred to a facility with dental radiology.

**Oral neoplasia:** The oral cavity is a common place to encounter neoplastic growths. It has been reported that oral tumors account for 6.7% of all malignancies in the cat and 5.3% in the dog.

Benign tumors are exceedingly rare in cats. By far, the most common malignant oral tumor in cats is a squamous cell sarcoma, with fibrosarcomas a distant second. Both of these types of tumors are typically seen in older cats, are locally aggressive, however are late to metastasize. The only therapeutic option at this point is early, aggressive surgery. The accepted minimum surgical margin of “normal” tissue for these tumors is 1 cm.

The most common oral growths in the canine are the epulids (fibromatous and ossifying), which are benign overgrowths of the periodontal ligament. They can grow very large, but are not invasive. They often respond to local incision, however curative surgery typically requires extraction of the tooth from which the tumor arose. Acanthomatous Ameiloblastomas (epulids) are locally invasive, however they do not metastasize. They respond well to excision with ½ cm margins and enjoy a 90% control rate with radiation therapy.

The most common malignant tumor in canines is malignant melanoma. Melanomas are not only locally invasive; they also metastizes very early in the course of the disease. A combination of aggressive surgery, radiation therapy, and chemotherapy is the best way to treat this disease process. However, the long term prognosis for patients with oral melanoma
is poor, generally due to systemic metastasis. An oral melanoma vaccine has been recently released that shows promise as an adjunct therapy for this disease process.

**Enamel hypocalcification (hypoplasia)**

Enamel is a very thin (<1mm) material on the surface of tooth crowns. Enamel is only formed prior to tooth eruption and cannot be naturally repaired after eruption into the mouth.

Hypoplasia/hypocalcification results from disruption of the normal enamel development.

The most common acquired cause of enamel hypocalcification of one or several teeth is trauma to the unerupted tooth.

A systemic infectious or nutritional problem may also result in improper enamel production. In these cases, most or all of the teeth are affected, but involve only a small part of the crown, usually a horizontal circumferential strip. Canine distemper was a common cause of this condition in the past, when prevalence of this infectious disease was highest.

Finally, enamel hypoplasia may result from a hereditary condition known as amelogenesis imperfecta. This condition is created by a decrease in the amount of enamel matrix applied to the teeth during development. In these cases, nearly all teeth are involved on all surfaces.

Areas of enamel hypocalcification will generally appear stained a tan to dark brown 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 exposes the underlying dentin, resulting in staining.

Dentin exposure results in significant discomfort for the patient. Every mm² of crown surface contains up to 45,000 dentinal tubules, each of which communicate with the root canal system. Dentin exposure changes the fluid dynamics within the tubules resulting in the sensation of pain (or sensitivity). It is rare for veterinary patients to show this discomfort, but occasionally anorexia may be the presenting complaint. Finally, the exposed dentinal tubules may act as a conduit for bacterial infection of the pulp, thus initiating endodontic disease.

Over time, the tooth responds to this exposure by laying down a layer of reparative dentin. Currently, there are no studies in animal patients documenting the time it takes for an effective reparative layer to be created. One human study documented that reparative dentin is seldom found prior to 30 days following exposure of dentinal tubules, and that the completion of formation is generally around 130 days. It is not known however, if this layer of reparative dentin is truly effective in decreasing tooth sensitivity.

Enamel hypoplasia (hypocalcification) is also associated with increased roughness of the teeth, which results in increased plaque and calculus retention, and in turn leads to early onset of periodontal disease.

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1 Canine Oral Melanoma Vaccine: Merial Limited.
For all of these reasons, prompt therapy of these teeth is critical to the health of the patient.

Treatment of this condition is aimed at removing sensitivity, avoiding endodontic infection by occluding the dentinal tubules, and smoothing the tooth to decrease plaque accumulation. The most efficient and effective way to accomplish these goals is placement of a bonded composite restoration. If the enamel damage is severe and the client is interested in a permanent correction, crown therapy can be performed. Alternatively, extraction may be performed. However, extraction is not the recommended course of therapy if the root structure is normal with no evidence of endodontic infection.

“Missing” teeth

There are several reasons that teeth may be missing. These reasons include: congenitally missing, previously extracted, fractured (or extracted) with retained roots (Figure 24) or impacted. The first two scenarios do not require therapy, whereas the latter two may necessitate intervention. Therefore, dental radiographs are indicated in all cases of “missing teeth”.

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Physiological And Pathological Tooth Root Resorption

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Deciduous teeth undergo physiological resorption to enable eruption of the secondary teeth. In some animals the secondary teeth do not develop and the deciduous teeth may remain in the mouth and remain functional for a number of years. Resorption of secondary teeth is common in cats and has been defined as type 1 or 2 and staged from 1-4 and 5 a&b. Type 1&2 resorption may occur concurrently on the same multi-rooted tooth. Idiopathic root resorption is becoming more prevalent in dogs.

This presentation will describe physiological and pathological resorption mechanisms and the treatment options currently indicated.
INTRODUCTION

Tooth resorption (TR) is a very common situation in domestic cats and is an external type of resorption (3,5,10). Tooth resorptions are characterized by a progressive resorption of dental structures, primarily of the cementum and progressively of the dentin and enamel, by cells called odontoclasts. They are present with different radiographic, clinical and histological patterns. They should be differentiated from internal root resorption which is characterized by resorption of the internal aspect of the root (5). The disease has many similarities with human multiple idiopathic root resorption (3). Resorptive lesions were described for the first time in the 1920’s, although a study revealed the presence of TR in domestic cats that lived 800 years ago (1,10,11). Various studies conducted on different populations of cats, demonstrated a prevalence of 27-68% (5). This wide range in the prevalence of the disease may be a result of different methodology in these studies (10). In some studies the examined cats were brought to dental clinics due to oral disease. This may result in a higher reported prevalence of TR compared with a randomly selected test population in other studies. Furthermore, in some studies intraoral dental radiographs were not used as a diagnostic method and maybe this underestimates the prevalence of dental TR (10).

The etiology of the disease is still unknown, although pathogenic descriptions have been well documented (5). According to some recent studies vitamin D, which appears to be in large amounts in some commercial cat food, may be responsible for TR (11). Another study suggests that lack of repair of lesions at the cement-enamel junction indicates that the mechanisms of replacement are absent or compromised in this region. Whereas resorption of the root may undergo repair, resorption at the cervix may progress to clinically evident lesions (3). Also, local pH changes and hypoxia may play a significant role in the pathogenesis of Feline odontoclastic TR, because of their inducing giant osteoclast formation with high resorptive activity (7,8).

The clinical signs of the disease could be: oral pain, ptyalism , anorexia and dehydration (4,6). When and if these signs are present, the disease process is already advanced by the time of the diagnosis. These signs are usually absent in early stages of the disease. General anesthesia is required to allow thorough periodontal and radiographic examination, which is indispensable
for TR diagnosis (4). Furthermore resorption without evidence of clinical disease is prevalent, and may occur in younger ages than previously reported. These early TR are being identified by using back-scattered electron microscopy and can initiate anywhere on the root surface (3).

Classification of TRs is based on periodontal space and alveolar bone radiological features. In type I resorptions the periodontal ligament space appears to be relatively normal and the radiodensity of the affected tooth is similar to the one of the adjacent tooth. In type II resorptions the periodontal ligament space is absent and root tissues are replaced by alveolar bone (5). The aim of this study is to reveal the prevalence and type of cats tooth resorptions in our country.

Materials and Method

This study is taking place in the Section of Surgery and Obstetrics of the Companion Animal Clinic, Faculty of Veterinary Medicine, Aristotle University of Thessaloniki. The cats examined so far are fifty-five, and are of mixed age, sex, breed and health status. All cats included in this study are being selected randomly among cats visiting our Clinic for various, dental or not dental, reasons.

A general health and dental chart is being completed for every cat, including the history, change in eating habits, diet, indoor or outdoor housing, previous dental care and whether the cats showed any signs of oral discomfort. Also, their sex and age are being recorded.

The cats are being anesthetized in order to be properly examined. An oral examination is being performed, which includes: survey, a dental explorer and a periodontal probe. All findings are being recorded on a dental chart.

After the oral examination, a full-mouth intraoral dental radiographic series is taking place, using a dental x-ray machine and an intraoral digital X-ray system. The bisecting angle technique is being used for the maxillary incisor, canine, premolar and molar teeth, and also for the mandibular incisor and canine teeth (9). The parallel technique is being used for the mandibular premolar and moral teeth. The diagnosis is based on clinical findings and/or radiographic signs of TR.

Results / Findings

Of the 55 examined cats TR were found in 39 cats, percentage 70.9% (11 lesions per cat). Type II resorptions were found in 36 cats and type I in 25. By clinical and radiological examination resorptions were detected in 17 cats, in 22 cats clinical examination revealed nothing and only radiographic examination depicted the lesions. Of the 39 cats with TR, only 6 cats had clinical signs of oral discomfort discovered by the owner.
Discussion

The preliminary results of our study show that the prevalence of tooth resorption seems to be higher than previous study findings in randomly selected cat populations. A study conducted in Sweden reported the presence of TR in 32% of 96 cats (10), whereas the present study reveals a much higher percentage. Although in this study the cats were selected randomly and were not presented for dental disease specifically, the high percentage of TR is similar to other studies based exclusively on dental patients ranging from 43% to 67%.

A statistically significant higher number of type II resorptions -compared with type I resorptions- has been found until now in our study -these results agree with Girard et al (2008) findings. Most of the studies that have investigated the prevalence of TR have shown a positive relationship between increasing age and the prevalence of TR (5,10). In this study the preliminary results are showing a strong relationship between the occurrence of TR and increasing age, but they also reveal that a respectable number of young cats seem to have quite a high percentage of TR at their teeth -these results are similar to the ones in DeLaurier’s et al (2009) study. It is also very interesting to note that many cats with advanced resorptions at their teeth didn’t show clinical symptoms identified by their owners.

Conclusions

Conclusively, according to our findings, type II lesions occur more frequently than type I lesions and radiographic examination is necessary for type II lesion detection. Furthermore, the absence of clinical signs does not exclude the presence of resorptive lesions and sometimes type II lesions are detected only after they have caused crown fracture. Eventually, the prevalence of TR in the examined cats is quite high and this reveals the necessity of an accurate clinical and radiographic examination, under general anesthesia, for a proper diagnosis.

References

Review of Oral Tumors in the Cat

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The oral cavity is the fourth most common site for feline neoplasia, accounting for 6.7% of all tumors in the cat. Most feline oral tumors are malignant, with 69% confirmed as squamous cell carcinoma and 18% as fibrosarcomas. Other tumors that occur much less frequently in the oral cavity are lymphosarcoma, osteosarcoma, chondrosarcoma, melanoma, mast cell tumors, and nasal and salivary gland adenocarcinomas. Benign oral lesions are less common, but must be differentiated from malignancies, and include ameloblastoma, epulides, eosinophilic granulomas, and gingival hyperplasia. Oral malignancies occur with equal frequency in male and female cats, and Siamese cats are disproportionately underrepresented in comparison to domestic shorthaired cats.

Cats with oral neoplasia often present with hypersalivation, halitosis, tooth loss, and facial deformity. Many of the cats have difficulty prehending food, and their coats are often unkempt because they are no longer grooming. Accurate diagnosis and staging is necessary to develop a treatment plan and provide the owner with a prognosis. Pre-operative lab work consisting of a chemistry panel, CBC, T4, UA, and FeLV/FIV test is indicated. Skull, chest and abdominal films are used to search for other primary or metastatic masses. Under anesthesia, a thorough oral exam and dental radiographs are performed on the feline patient. An excisional biopsy of the mass is submitted for histopathology and aspirates are made of regional lymph nodes to screen for metastasis. Measurements of the mass are performed and noted. The World Health Organization has formulated a tumor staging classification – primary tumor, regional nodes, metastasis (TNM) - for canine and feline tumors of the lips and oral cavity. The size, location, and extent of the disease will dictate whether the mass can be treated with surgery, radiation therapy, chemotherapy, or a combination of modalities.

In general, the prognosis after any type of treatment worsens as the stage of the tumor increases from I to IV.

Squamous cell carcinoma is the main oral tumor in cats and occurs primarily in the gingiva and tongue; and unlike dogs, occurs infrequently in the tonsillar epithelium. Mucosal ulceration, bleeding, necrosis, and severe suppurative inflammation are hallmarks of the disease. Cats frequently present for evaluation of an enlarged jaw, due to osteolysis and invasion of the underlying bone. Oral squamous cell carcinoma grows rapidly in cats and is extremely resistant to almost all forms of surgical, medical and radiation therapy. The median survival time in cats with oral squamous cell carcinoma is 6 months. Mandibulectomy and radiation therapy increased the median survival time to 11 months, with a one year survival rate of 57%. 76% of the cats that underwent mandibulectomy experienced adverse effects such as ptalyism, dysphagia, and difficulty grooming for the remainder of their lives.
Death due to distant metastasis is rare, as most cats are euthanized because of progressive local disease.\textsuperscript{xlii}

A recent investigation into the in vivo and in vitro effects of Zolendronate, a human cancer drug, on oral squamous cell carcinoma in cats suggests that this drug might hold some promise in slowing the progression of the disease process.\textsuperscript{xliii} It slows tumor growth by inhibiting angiogenesis, which is characterized by endothelial cell proliferation, migration, and lumen formation.\textsuperscript{xliv} Zolendronate also inhibits malignant osteolysis, the tumor-induced bone resorption that occurs with oral squamous cell carcinoma and other malignant skeletal neoplasms.\textsuperscript{xlv} In humans, reduction in osteolysis is important in reducing neoplastic progression and dramatically improves pain and quality-of-life scores.\textsuperscript{xlvi}

The relationship between the risk of oral squamous cell carcinoma (OSCC) and factors such as environment tobacco smoke, flea control products, and diet was examined in 36 domestic cats with confirmed OSCC and 112 renal disease control cats.\textsuperscript{xlvii} Cats with owners who smoked had a fourfold increase in the risk of OSCC compared with cats from households of non-smokers. Cats that wore flea collars had a five time greater risk of developing OSCC compared with control cats. Interestingly, those regularly bathed in flea shampoo had a 90% reduction in risk, indicating regular shampooing reduced contaminants on the coat that could be enter the oral cavity via grooming. Cats that frequently ate canned food had a threefold increase in OSCC compared with those that ate only dry food. Cats with canned tuna ingestion increased the risk fivefold.\textsuperscript{14}

Fibrosarcoma is the second most common malignant feline oral tumor. The tumor is locally invasive and prone to rapid recurrence after surgical excision, but is slow to metastasize.\textsuperscript{xlviii} In cats, it appears to be more aggressive and destructive than in dogs.\textsuperscript{xlix} It is generally radiation resistant and carries a poor prognosis. Lymphosarcoma occurs in 3.5% of cats, but the oral cavity is usually not the primary tumor site. Hypercalcemia associated with systemic lymphoma rarely occurs with the oral form.\textsuperscript{1} Adenocarcinomas arising from the nasal epithelium or salivary gland tissue located in the oral mucosa occur occasionally. These tumors are invasive, friable, and tend to cause discomfort. Like osteosarcoma, these tumors metastasize more slowly than others, and yield longer survival times if wide local resection is possible.\textsuperscript{17} In cats, 39% had nodal involvement at the time of diagnosis.\textsuperscript{1} Melanoma is very rare in cats, but carries a very poor prognosis. The most frequent sites of occurrence are the gingiva, lip, and palate. Oral melanomas grow rapidly, are extremely invasive, and metastasize early.

In conclusion, oral tumors in the cat are a significant cause of mortality. Early recognition and diagnosis is paramount to improving the cat’s response to therapy. 90% of all tumors still carry a poor prognosis. However, feeding a diet of dry food and avoidance of environmental pathogens such as cigarette smoke and pesticides could help reduce the incidence of feline oral cancer. In addition, early multimodal treatment with surgery, radiation, and chemotherapeutic agents may provide better survival times for affected individuals.
References

The eosinophilic granuloma complex is not a disease itself, but rather a reaction of the organism to one or several triggering agents. This reaction may occur in horses, dogs, and most common in cats. There exist various types:
- the ulcerative type which is not painful, situated mostly near the lips.
- the plaque type, often in the area of the inner thighs.
- the granuloma type, in the mouth and on the paws.
Whereas all these types can be found with cats, dogs and horses are only afflicted with the granuloma type.

The eosinophilic granuloma complex is named after the eosinophilic leukocytes; they can be detected histologically in all these changes. There exist two hypotheses how the cells get there:
1. Eosinophilic granulocytes leave the blood stream.
2. Precursor cells change to eosinophilic granulocytes.

Histologically, besides eosinophilic leukocytes, mastocytes and lymphocytes are found as well. They support the event immunologically. It is discussed what may possibly trigger the event:
1. contact allergies, e. g. animal feed, fleas, parasites, or any other contact allergen
2. Th2-supported hypersensitivity towards constantly existent antigens
3. genetic predisposition
4. autoimmune reaction
5. For cats, the following is considered possible: Cats have allergens in their saliva. It is proven that within a few hours eosinophilic cells can be found at the mucocutaneous zone.
6. idiopathic

All these triggering agents can be subsumed in an immunological event. It has not been resolved, however, how the different types originate and why in cats they may occur in parallel.
It is assumed that cats have the following predisposition:
1. Sex: Mainly female cats develop the ulcerative type.
2. Age: in case of the generalized eosinophilic granuloma: two to six years of age
3. Genetics: the idiopathic type is found often accumulated in certain families of animals, (starting often at the age of two)
4. Allergies ( also starting often at the age of two)
5. An infection with FeLV and FIV

For dogs the following predispositions are assumed:
1. Race: Siberian Husky and Cavalier King Charles Spaniel (perhaps genetic)
2. Age: about three years of age
3. Sex: About 72 percent are male.

For diagnostics several examinations can be made:
1. Histology
   Biopsies and impression preparation. Depending on the basic type very different patterns can be detected.
   In the granuloma type eosinophilic cells can be found, histiocystic granuloma with collagen degeneration. They may have either a closed or ulcerated surface.
   In the eosinophilic plaque type mainly the skin is affected. It is either a matter of a hyperplastic, superficial or a profound perivascular to diffuse eosinophilic dermatitis.
   In the ulcerative type there may be found a hyperplastic ulcerous, superficial, perivascular to interstitial dermatitis and fibrosis. As inflammatory cells there may be seen mainly neutrophilic and mononuclear cells, eosinophilic ones rather seldomly. Here one assumes that eosinophilic cells are to be found only in its initial stage.
2. Allergies

Tests can be carried out via blood or skin. If intolerance towards feeding stuff is suspected, a diet by elimination should be considered. Besides, the animal should be controlled for fleas and parasites; they should be eliminated.

In the case of an allergenic background the activator should be identified. This, however, may prove to be very difficult and also tedious. Compounding the problem, secondary infections often exist and have to be treated as well. In every type of the eosinophilic granuloma complex a treatment with glucocorticoid is possible:

**Cats**
1. Methyl prednisolone acetate 20 mg/cat or 4 mg/kg sc every two to three weeks. Alternatively, prednisolone 2 mg/kg every twelve hours. After two to four weeks the condition should be improved. As soon as this happens, prednisolone or methyl prednisolone acetate should be reduced gradually to the minimum effective dosage, prednisolone given every two to three days, methyl prednisolone acetate given every two to three months. Alternatively either triamcinolone (0,8 mg/kg every 24 hours) or dexamethasone (0.4 mg/kg every 24 hours) can be administered. In case of recession or even healing the dose administered should be reduced as well.
2. Should the application of glucocorticoids not be successful, alternatively trimethoprim/sulfa (125 mg/cat every twelve hours), doxycyclin (5 to 10 mg/kg every twelve hours), or cyclosporin (25 mg/cat per day) may be administered.
3. Megestrol acetate 2.5 -5 mg/cat or 0.5mg/kg every two to seven days.

**Dogs**
1. Dogs are treated as in case of atopy: Corticoids like methyl prednisolone (0,2 to 0,4 mg/kg) and prednisolone (0,25 to 0,5 mg/kg) are given every twelve hours. When the condition improves, methyl prednisolone (04 to 0,8 mg/kg) or prednisolone (0,5 to 1,0 mg/kg)
is given every 48 hours; for a permanent therapy, the dose of methyl prednisolone should be less than 0.4 mg/kg and of prednisolone less than 0.5 mg/kg.

2. Cyclosporine (5 mg/kg) may also be given. The condition should improve after four to six weeks. Then the time per medication may be increased to 48 to 72 hours. There are such dogs, however, that will need a daily dosage as long term treatment.

3. Also antihistamines can be used in treatment. Among them, several may be used in combination with glucocorticoids and essentially fatty acids:
   - diphenhydramine, 1 to 4 mg/kg every eight hours
   - amitriptyline, 1 to 2 mg/kg every twelve hours
   - clemastine, 0.05 to 1.5 mg/kg every twelve hours
   - cetirizine, 0.5 to 1 mg/kg every 24 hours
   These are only some antihistamines that may be given.

4. Supporting the therapy, essentially fatty acids can be given orally.

Instead of the above therapies, it is recommended time and again to remove the lesions surgically, to treat them by laser, electrically, or by Co2, or even to underject the lesions locally with corticosteroids. But these are only supportive measures that may improve the healing, as is the treatment with antibiotics for a prolonged period of time.

All these therapies for dogs and cats have good prospects only if the basic illness can be controlled successfully. In case of permanent treatment one should always expect secondary effects.

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42 Good Arguments On 4 Paws: Veterinary Dentistry For The Military Working Dog. Experiences At The Bundeswehr Military Working Dog Veterinary Clinic

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Introduction

The Bundeswehr Military Working Dog Clinic is responsible for the veterinary care and treatment of all Bundeswehr Military Working Dogs, especially in the field of veterinary dentistry. This presentation is about experiences in the field of dental disease diagnosed and treated at the Bundeswehr MWD Clinic during MWD Pre-Purchase Veterinary Examinations and in the MWD Clinic’s Outpatient Treatment Section.

Materials and Method / Case Presentation etc.

The Bundeswehr purchases dogs at the average age of 18 months. Besides other tests, the dog has to pass a Pre-Purchase Veterinary Examination. The Pre-Purchase Veterinary Examination consists of a detailed general veterinary examination both conscious and under general anaesthetic, including x-rays minimum of elbows, hip joints, vertebral column and upper/lower jaw. The age of the dogs is determined by the Tierbild® Software for digital age determination via x-ray of the upper canine.

The examination sheets of the MWD Pre-Purchase Veterinary Examinations between 2007 and 2009 were reviewed and evaluated concerning dental disease.

After purchase, the dog enters basic and specialist training at the Bundeswehr School of Dog Handling. The Bundeswehr MWD Clinic is the Bundeswehr’s central facility for MWD Veterinary Care and keeps the health records of all active and former Bundeswehr MWD’s. Currently there are about 750 active MWD’s in service.

In most cases, a dental disease is diagnosed by the Bundeswehr MWD Clinic in the scope of a general and special clinical examination conducted for other reasons. As far as possible, dental problems requiring treatment will be remedied during the same therapeutic session. Time-consuming treatments are scheduled an extra appointment.

The examination sheets of appointments scheduled exclusively for Dental Treatment in the MWD Clinic’s Outpatient Treatment Section during 2007 and 2009 were reviewed and evaluated.

Results / Findings
Data could be collected from 354 MWD Pre-Purchase Veterinary Examinations in 2007 to 2009. The average age of these dogs was 1.9 years. 176 dogs (49.7%) were diagnosed with dental disease. 100 dogs (28.2%) had accumulated calculus and gingival inflammation/periodontal disease. 39 dogs (11%) exhibited severe attrition of the teeth resulting from cage-biting or chewing on objects. 38 dogs (10.7%) were diagnosed with fractured teeth.

In 2007 to 2009, the Head of the Internal Medicine and Outpatient Treatment Section conducted 250 scheduled dental treatments. Taking into consideration that a total of 3067 general and special treatments were conducted at the MWD Clinic during that period, this implies that 8.2% of all MWD´s scheduled for treatment were treated in the field of Veterinary Dentistry; in 2009 it was even 12% with 63 out of 526 appointments. The average age of these MWD´s was 5.1 years. 190 MWD´s (76%) had accumulated calculus and gingival inflammation/periodontal disease. 160 MWD´s (64.0%) were diagnosed with fractured teeth (single and multiple fractures); 240 teeth received endodontic treatment. 179 teeth were extracted. 62 MWD´s (24.8%) received prosthodontic treatment. Orthodontic treatment was performed in one MWD.

Discussion
According to various publications, with a morbidity rate of more than 80%, dental problems are the most common disease of adult dogs. Poor dental health is common in dogs offered to the German Military for purchase as MWD´s. Bundeswehr MWDs often suffer from injuries and diseases relating to the oral cavity, teeth and periodontium.

Conclusions
The dog´s and MWD´s welfare and fitness for duty can be fully restored by meticulous diagnosis, control and if necessary, sophisticated state-of-the art treatment. Prophylactically, this includes the training and information of the soldiers responsible for the MWD´s to increase awareness of dental disease and to avoid unnecessary risks to the dental system.
Periodontal disease as a potential factor of systemic inflammatory response in the dog

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Introduction

Periodontal disease is an inflammatory process mediating destruction of periodontal tissues, triggered by bacteria pathogen. There are a number of reports suggesting a connection between periodontal disease and systemic inflammatory response. Increasing evidence indicates that chronic infections, as well as inflammatory mechanisms play a major role in atherogenesis and cardiovascular disease and other systemic conditions in human. The immune system responses quickly at any potential pathogen, by the release of pro-inflammatory cytokines from macrophages during the acute phase reaction. The acute phase reaction, is considered a part of the innate host defense system, which is responsible for the survival of the host during the critical early stages of attack. In evolutionary terms, this means that it predates the acquired immune response. As a part of the acute phase reaction, the synthesis of acute phase proteins (APPs) starts in the liver. There are APPs that increase in concentration and are called positive and others that decrease and represent the negative APPs. In the dog, C-reactive protein (CRP) and Serum amyloid A (SAA) represent the major APPs. This means that they are the first to rise in case of inflammation and their concentration is the highest of all the major APPs. On the other hand, albumin is their most important negative counterpart. Although their physiologic role is still not well understood, it is apparent that APPs are involved in the regulation of the immune response, inflammation, protection against infection, and in the repair and recovery of damaged tissue. The same individual APP can have both a pro- and anti-inflammatory effect, with a delicate balance between the 2 functions. The objective of this study was to determine whether periodontal disease causes systemic inflammatory response in otherwise clinically healthy dogs.

Materials and Method / Case Presentation etc.

Forty six dogs of various breeds and ages that had been admitted in our Clinic, for routine or oral procedures, have been included in this study up until now. The criteria to be fulfilled for a dog to be enrolled in the study, was to be clinically healthy, with normal biochemical and hematological profile and receiving no kind of drugs. Accordingly, blood was taken from every animal, before receiving general anesthesia. The blood was then centrifuged in 3500 x g
for 15 minutes and the serum samples collected were stored frozen until analyzed. Serum CRP and albumin concentration were measured in every animal’s serum. Moreover, the total mouth periodontal score (TMPS, Harvey C.E.) was estimated separately, for gingival bleeding index and periodontal destruction (TMPS-G and TMPS-P, respectively) by using a periodontal probe in every dog, under general anesthesia. Severity degree and the measured parameters were tested for linear regression. Subsequently, the dogs were arbitrarily divided into four groups, according to TMPS-G and TMPS-P degree, the means of which were tested with ANOVA by the use of a general linear model.

**Results / Findings**

All the dogs that suffer from periodontal disease of any degree had increased-above reference rates-CRP serum concentration levels. Albumin serum concentration levels were decreased, but within normal ranges. There was a statistically non-significant linear regression between TMPS-G and albumin concentration (p=0.191), TMPS-G and CRP (p=0.083), TMPS-P and albumin (p=0.707), and TMPS-P and CRP (p=0.708). ANOVA revealed a) non-significant differences of the means of albumin concentration (p=0.168) and CRP (p=0.331) among TMPS-G classification groups, and b) non-significant differences of the means of albumin concentration (p=0.599) and CRP (p=0.932) among TMPS-P classification groups. However, there was a significant linear regression between albumin and CRP (p<0.0005, r²=0.354).

**Discussion**

In human dentistry, increasing evidence implicates periodontitis, as a potential risk factor for increased morbidity or mortality for several systemic conditions including cardiovascular disease (atherosclerosis, heart attack, and stroke), pregnancy complications (spontaneous preterm birth), respiratory tract infections, chronic kidney disease and diabetes mellitus. In addition to that, the measurement of CRP concentration levels is a very important tool in critical care units. In veterinary dentistry, periodontal disease has also been associated with bacterial endocarditis, kidney and liver abscesses upper respiratory tract disease and diabetes mellitus. It is widely accepted that periodontal disease, is not only a localized disease but also results in systemic bacteraemia and release of inflammatory mediators. This may lead to organ dysfunction in humans. Systemic markers of inflammation, such as C-reactive protein, have been shown to be elevated in the serum of patients with periodontitis. A recent study conducted in 38 dogs, looked at the association between the concentration of systemic inflammatory parameters (including serum C-reactive protein, urine:creatinine ratio, blood pressure, microalbuminuria) and severity of periodontal disease and then, after appropriate treatment of the disease, the changes in these systemic parameters. The same study showed that increases in the concentration of systemic inflammatory markers were positively correlated to the severity of periodontal disease. After periodontal therapy, there was a significant decrease in the concentration of some of the inflammatory markers. In the present study, we found that all the dogs suffering from periodontal disease, also exhibited
laboratory findings of inflammation i.e. increased serum CRP and decreased serum albumin. However, we found statistically non significant linear regression between the extent and the intense of periodontal disease. This might be due to qualitatively different genetic predisposition or some other mechanism of increased acute-phase response to any source of infection. Data that is constant with ours has also been published in human dentistry. The results of our study, support the significance of maintaining periodontal health. Dental prophylaxis, should be targeting towards shielding our patient’s general health and not just alleviating halitosis. On the other hand, a dog with heavy periodontal disease is not expected to have extremely high CRP levels. The latter finding should raise the suspicion of a bacterial or even a subclinical disease that would cause an intense inflammatory response.

Conclusions

In our study so far, we draw the conclusion that periodontal disease seems to cause a low grade systemic inflammatory response in the dog. However, it seems that the width of changes in the systemic parameters measured (C-reactive protein, albumin), maybe is not constant with the extent of periodontal disease.

References


Dental Restoratives: Composites and Bonding Agents

Louis J. Visser, DDS

Dental Composite

What is a Dental Composite?

Dental composites typically consist of a resin-based oligomer matrix, such as a bisphenol A-glycidyl methacrylate BISMA or urethane dimethacrylate (UDMA), and an inorganic fillers such as barium glass or quartz. Compositions vary widely depending on attributes desired by the user. Different combinations of resin matrices and fillers lead to different characteristics of the composite. Varying the type of filler can change a composites wear resistance, viscosity and translucency.

Composites are classified by how they initiate to full cure, filler size, and viscosity.

Initiation

1. Self cure(or autocure) composites have a chemical initiation that converts a monomer to polymer. Some core build up materials can be self cure.
2. Dual cure means chemical initiation is used and combined with photochemical initiation so either and both techniques polymerize composite. Dual cure composite are commonly used as a cementing medium under crowns. For example, Panavia, MultiLink
3. Light cured composite means photochemical initiation causes polymerization. A curing light is used to polymerize composite. For example, Filtek Z250, Herculite, TPH

****A dental curing light has a light wavelength between 420 nm and 450 nm. A setting catalyst in the composite is sensitive to this wavelength and is then activated which causes polymerization.

Fillers

Composite fillers are classified by material, shape and size. Strontium glass, barium glass, quartz and other materials are used as fillers. Fillers decrease polymerization shrinkage of composites and affect other characteristics like strength and polishabilty as well
1. Fillers greater than one micron are referred to as macrofills
2. Fillers less than one micron are referred to as microfills.
3. A new classification of filler is the nano particles. The nano particles fill between all other particles to further reduce shrinkage.

A mixture of different particle sizes is referred to as a hybrid. More and more composite today are hybrids of some sort. Hybrids tend to have higher strength values, less polymerization shrinkage, and higher polishability. These hybrids are sometimes called Universal Composites.

**Viscosity**

Viscosity determines flow characteristics during placement. The composite can either be a firm paste like consistency, or more fluid like honey.

**Flowable Composite Resin**

1. represents a modification of the hybrid composite resins whereby the filler particle content has been reduced slightly and the particle size and distribution has been altered in order to improve the handling property of flow

   a. most materials in this group have filler particle loading of 55% to 65% by weight
   b. the principal advantage is that restorative material placement is easier because the material is not as stiff as the hybrids.
   c. because they contain less fillers (or more resin), they exhibit a greater degree of flexibility than do the other hybrids

**When Do We Use A Dental Composite?**

In veterinary dentistry dental composites are most often used for procedures like sealing the access to the pulp chamber after root canal therapy, vital pulp therapy, repairs of fractured teeth or stained teeth, restoring a tooth after caries removal, and orthodontics.

**How Does The Composite Stick To The Tooth?**

**Principles of Adhesion (Bonding)**

A. Definition: The attachment of one substance to another.
   -Adhesion refers to the forces or energies between atoms or molecules at an interface that hold two phases together.
1. **Adherend**: The surface or substrate that is adhered to.

2. **Adhesive (adherent, bonding agent)**: The material that when applied to surfaces of substances, can join them together, resist separation, and transmit loads across the bond.

### History of Dentin Bonding Materials

**A. First Generation Materials** *(no longer really used)*

1. acid etch the enamel and perhaps make some effort to condition the dentin

2. far more useful for enamel than for dentin
   - enamel bond strengths = 20 to 25 MPa
   - dentin bond strengths = 2 MPa

**B. Second Generation Materials** *(no longer really used)*

1. featured a weak bond to dentin that involved attaching to the smear layer

2. dentin bond strengths = 4 to 5 MPa

3. basic mechanism of action of this group is to chelate to the calcium of tooth structure, which for the early materials, meant chelating to the calcium of the smear layer

4. *smear layer* is a *layer of proteinaceous debris on the tooth formed by a cutting or abrasive action on dentin*

**C. Third Generation Materials** *(No longer really used)*

1. introduced a two component primer and adhesive system *(some 3rd Generation had 3 components)*
   a. the primer was to be placed on dentin
   b. the adhesive was to be placed on primed dentin and on etched enamel

2. dentin bond strengths = 10 MPa

3. did not rely on the smear layer for attachment; in fact, the primers either removed or altered the smear layer resulting in opened dentin tubular orifices and increased micromechanical retention
D. Fourth Generation Materials—“Total Etch” or “Etch and Rinse” Systems

1. characterized by **hybrid layer** formation
2. dentin bond strengths = 18 MPa
3. fourth generation materials contain a dentin primer and an adhesive as two separate materials to be applied to the tooth as two separate steps
4. Must be meticulously used or post op sensitivity can occur on vital teeth

*Considered by some the Gold Standard along with the 5th Generation*

E. Fifth Generation Materials—“Total Etch” or “Etch and Rinse” Systems

1. single component system with the **primer and the adhesive agents combined to form a single liquid material.** These are essentially distinguished by being one-step or one-bottle products. This is a bit of a misnomer because these products are applied in two steps; first a phosphoric acid etchant is applied to the tooth structure and then the **dentin bonding** agent is applied.
2. features etching the enamel and the dentin
3. features the “moist bonding” technique
4. dentin bond strengths = 20 to 25 MPa
5. Acid conditioning of dentin:
   a. removes smear layer and smear plugs
   b. permits micromechanical adhesion similar to enamel
   c. Once these tubules are “opened”, they MUST be sealed properly with the adhesive. If they are not sealed well there will be resultant tubular fluid movement, resulting in sensitivity.
   d. The collagen in dentin is NOT removed by etching, therefore it is exposed as the surrounding mineral is dissolved. This leaves the
superior surface of etched dentin with a 5-10 micron thick layer of “hair” or collagen fibrils
e. Once the dentin is etched, the primer/adhesive is placed and penetrates the collagen fibrils. Following its polymerization the **HYBRID LAYER** is formed. The same process that enabled fibril layer penetration also enables the primer and adhesive mixture to penetrate the tubular openings. Once the resin primer/adhesive is polymerized, the tubular openings are sealed. Both of these latter phenomena assist in the development of mechanical retention.

6. **Hybrid Layer:** The zone in which resin of the adhesive system micromechanically interlocks with dentinal collagen.

7. in order for reliable dentin bonds to develop, the surface must not be over-dried (desiccated). Additionally, it should not be over-etched

   a. over-dried = collapse of collagen fibrils to form a thick “mat” on the surface that is not as readily penetrated by the primer/adhesive

   b. over-etched = depletion of surface calcium to rob GPDM of bonding sites **AND** exposes too much collagen fibrillar structure for the primer/adhesive to penetrate (a phenomenon similar to over-drying.)

8. must be meticulously used or post op sensitivity can occur

   ****Prime and Bond NT is an example of a 5th generation

   *Considered by some the Gold Standard along with the 4th generation*

F. Self Etching Primers (sometimes called 6th and 7th generation)

1. These systems employ the use of acidic monomers that penetrate the smear layer, demineralize the mineral portion of dentin, and infiltrate intertubular and peritubular dentin

2. Since phosphoric acid is not applied and rinsed off, collagen is not left exposed and vulnerable to dessication and collapse during the period between etching, rinsing and primer application.
3. The smear layer is never removed. This debris is incorporated into the bonding layer.

4. By removing the potential for collagen fibril collapse and the concern for “wet” bonding, the potential sensitivity resulting from inadequate sealing of exposed tubules is avoided.

5. Since these systems “etch” and prime to the same depth, the concern for nanoleakage, or areas etched but not penetrated by monomers, is eliminated.

6. **Self Etching Primers contraindications:**
   a. Most do not bond well to uncut enamel

   *6th Generation has two ingredients – one being an acidic primer and wetting agent and the other being unfilled bonding agent*

   *7th Generation bonding agents usually are usually composed of just one ingredient., with all constituents placed in one application*

**Self Adhesive Composites**

A newer composite that has been introduced that does not require a bonding agent to be used with it.

Successfully used in cementing crowns, bond strengths are still questionable to be used as a restorative material only

**Dentin vs Enamel Bonding**

1. Enamel Bonding is strong when properly done and will last a long time (many years)
2. Dentin Bonding is less predictable, both the self etch and etch and rinse have received similar bonds to dentin. Consider a bond to dentin a bonus when it happens, don’t count on it
Clinical Factors That Will Affect Dentin Bonded Restorations in Total Etch Systems

Collagen Fibril Collapse

1. Once the collagen fibril in dentin is exposed, these fibrils are left vulnerable to levels of moisture present on the dentin surface.

2. These collagen fibers MUST be suspended in a reasonable amount of water so that they will remain “fluffy” or “floating” in such a way that they don’t obstruct the infiltration of bipolar primers as they wet the demineralized intertubular dentin and pass into the tubules to wet the peritubular dentin.

3. If the dentin is inadvertently or deliberately air dried to the point that not enough water is present to “float” or suspend the collagen fibers, these fibers may clump together forming a impenetrable “mat” or barrier to the primers.

4. Desiccating preparations that expose both enamel and dentin is CONTRAINDIATED.

How wet is “wet”?

1. Leaving too much water on the tooth after rinsing the etchant off weakens the dentin bond and increases the likelihood of postoperative sensitivity.

2. Too much water creates an “oil and water” type suspension, and water blisters form on the overwet dentin surface. These water blisters cause a phase separation in the primers, and disperse them unevenly across the demineralized dentin surface and into the dentin tubules.

3. Failure to get adequate primer coverage over and into the tubules produced unacceptable bond strengths and permitted fluid movement within the unsealed tubules.

4. “Damp” dentin is ideal. It is sufficient to keep the collagen “fluffy”

How to prevent “overwet” or “overdry” dentin

1. Never desiccate or blow air into the prep. ENAMEL CAN BE LEFT WET, ALONG WITH THE DENTIN

2. Steps for “moist” dentin:
   a. Etch enamel and dentin according to manufacture instructions, no longer

   b. Rinse thoroughly with air/water spray for 5-10 seconds
c. Dry the working field around the prep, NOT THE PREP ITSELF!

d. Using the high volume suction (if available), seal the suction directly on top of the prep for 2-3 seconds
   i. Inspect the prep. This should remove excess, flowing water from the prep. Repeat if necessary.
   ii. At times, it may be necessary to dip a microbrush into the prep to blot away excess

**How Do We Place A Composite?**

**Total Etch**

1. **Removal of tooth structure** As a general rule for endodontics, caries removal, or any other invasive procedure preparation should be limited as much as possible. Adequate access for root canal therapy instrumentation and complete caries removal is a must, but there is no replacement for good tooth structure. In other words, nothing beats the real thing. Don’t take away more tooth structure than you need to.

2. **Use of a Liner or Base** If indicated due to the proximity to the pulp, a calcium hydroxide liner can conservatively be placed in the deep part of the preparation believed to be close to the pulp. Then a glass ionomer should be placed over the calcium hydroxide. If root canal therapy is performed a glass ionomer can be placed over gutta percha to prevent any eugenol from sealer affecting the bond of our composite. A base or a liner is not always necessary.

3. **Acid Etching** The walls of the preparation should be etched with 37% phosphoric acids for 15 seconds and then rinsed (these numbers vary depending on which brand you are using, READ THE DIRECTIONS AND FOLLOW THEM)

4. **Application of Bonding Resin** The manufacturers directions should be closely followed. 5th generation bonding systems typically have a single bonding agent that is placed, air dried for 5 seconds, then light cured for 20 seconds. Again follow the directions closely for whatever system you are using.

5. **Composite Placement** A thin layer of flowable composite can be placed initially. Due to the properties of flowable composite a more intimate fill might be achieved. Light cure for 40 seconds (again follow the directions closely for whatever system you are using) Then incremental layers of composite no thicker than 2mm should be placed and then light cured for 40 seconds before another increment can be placed. And do this until the entire preparation is filled.

6. **Finishing** the composite should be polished and smoothed. Take care to ensure no rough or sharp edges are left. They can irritate and cut gums, cheeks and tongues! Excess bulk should also be removed to ensure no occlusal prematurities exist.
For Self Etch Systems all the above steps are followed except #03 and #04. The primer and adhesive will be used at these stages instead. This system will vary slightly depending on which brand you use.

Pulpal Protection For Resin Restorations

A. Two Types Of Materials

1. calcium hydroxide compounds (CaOH)

2. glass ionomer cements

B. General Considerations For Pulp Protection With Resins

1. ALWAYS placed when dentin thickness is 1 mm or less

   a. restorative material can be irritating

   b. etchant can be irritating

      (1) the placement of a phosphoric acid etchant on dentin will cause a decalcification of the dentin and a widening of the dentin tubules. This will increase dentin permeability and create an avenue for undesirable materials to gain access to the pulp.

      (2) studies have been conducted on healthy teeth in which the dentin was exposed to a 60 second contact with phosphoric acid. Although micro-abscesses form in 15 days, by 45 days, most histological indicators had returned to normal.

2. only a thin layer of base is needed

   a. not needed for thermal protection since resins are not good thermal conductors

   b. used as a barrier to chemical irritation and/or to stimulate a healthy pulpal response

3. DO NOT use cavity varnish or eugenol containing compounds

   a. interfere with resin polymerization

4. when necessary to place a pulp protecting material, it should only be placed over the deepest dentin that overlies the pulp. It should not be placed on enamel

C. Calcium Hydroxide Compounds
1. easy to mix and apply
2. may stimulate pulpal repair or at least create environment that allows pulp to repair itself
3. just apply to deepest area, don’t need a lot.
4. place CaOH compound first over deeper aspects of preparation closest to the pulp, then place glass ionomer liner over CaOH and shallower dentin not covered with the CaOH

D. Glass Ionomer Cements

Glass Ionomer Cement

What is a Glass Ionomer Cement?
Glass Ionomer Cement (GIC) is one of a class of materials commonly used in dentistry as a filling material, liner, base, or a luting material.

The basic composition of glass ionomer materials is a powder/liquid formulation

a. powder is alumino-silicate glass formed by heating particles of quartz, alumina, metal fluorides and metal phosphates until they fuse and then grinding this to form a fine powder

b. liquid is primarily a polyacrylic acid

   (1) polyacrylic acid can form hydrogen bonds to calcium

   (a) results in a chemical bond to tooth

c. this is how they get their name--formation of ionic bonds using a glass compound

d. to be a glass ionomer, the constituents, when combined, must produce an acid base reaction

So in other words a glass ionomer is a hybrid of the silicate cements and the polyacrylate materials that produces a restorative material that will bond to dentin.
It is the only material that will bond to tooth structure without etching and the use of an adhesive!!!

What are Glass Ionomers Cements used for?

The are six general use-based classification of GICs, the types are as follows:

1.) Type I – Used as a luting cement. For example cementing a crown.
2.) Type II - For restorations
3.) Type III - Liners and bases. For example placing as a liner over gutta percha during RCT, or placing over MTA during a Vital Pulp Therapy procedure. Placing a Glass Ionomer on tooth structure as a liner with composite placed over it is commonly referred to as the “Sandwich Technique”. There may be some added protection against microleakage by incorporating the “Sandwich Technique”
4.) Type IV - Fissure sealants
5.) Type V - Orthodontic Cements
6.) Type VI - Core build up. For example building a tooth up after a fracture or caries removal prior to placement of a crown

How are Glass Ionomer Cements Placed?

There are essentially two methods by which this material can be induced to set or polymerize;

1. by autocuring means as a result of combining the powder with the liquid and allow it to sit undisturbed until material sets
2. by exposure to a curing light following the combination of the powder and the liquid

Placement Steps

1. make sure dentin is clean and dry
2. can pretreat dentin with polyacrylic acid for 20 to 30 seconds, followed by a water rinse and air drying to remove the surface debris (termed the "smear layer") and increase hydrogen bonding. The polyacrylic acid also serves as a good wetting agent by lowering the surface energy of the dentin so the glass ionomer will flow over the surface and make better contact with the tooth. This will result in better mechanical and chemical bonds. This is a step recommended by the manufacturer to enhance attachment to dentin, however, probably not essential for most base and liner situations where the cavity preparations have sufficient internal retention to retain the base
3. Apply material to clean and dry dentin, DO NOT APPLY TO ENAMEL.

4. If a Visible Light Cure Material, cure to manufacture recommendation, if Autocure Material, allow to cure to time specified by manufacturer.

5. If a base thickness of greater than 2mm is desired, the material should be placed in increments (unless it is an autocure), curing each 2mm separately before adding the next, until the desired thickness is achieved.

**What are some strengths and weaknesses of Glass Ionomer Cements?**

**Strengths**

1. Mild pulpal response due to large size of polyacrylic acid molecule that essentially prevents its diffusion through the dentin tubule unless placed in close proximity (within 1mm) to the pulp where the tubules are wider.

2. Potentially prevents caries due to fluoride ion release into surrounding tooth structure.

3. **Chemical bond to dentin** through attachment to calcium.

4. Biocompatible as long as they are not placed within 1mm of Pulp.

**Pulp**

5. On a vital tooth may reduce post-operative sensitivity by bonding to dentin thereby reducing the formation of gaps between the restoration and the tooth which minimizes restoration flexure and tubular fluid “pumping”.

**Weaknesses**

1. The main limitation of the glass ionomer cements is their relative lack of strength and low resistance to abrasion and wear. Conventional glass ionomer cements have low flexural strength but high modulus of elasticity, and are therefore very brittle and prone to bulk fracture.

2. The material, either autocure or visible light cured, does not stimulate pulpal repair; if preparation is deep (to within 1mm of the pulp), a CaOH material should be placed first and this CaOH should be confined only to the deeper areas.
**Hybrid Glass Ionomers**

Hybrid glass ionomer is a term coined to describe the variation in glass ionomer cement products from the basic alumino-silicate glass and polyacrylic acid formulation.

A. two types of "hybrid" materials

1. Those that use both an *acid/base reaction* and a *resin polymerization* mechanism to achieve setting. These are commonly referred to as *resin modified glass ionomers*.

2. Those that add glass ionomer powder (aluminosilicate glass) to a Visible Light Cured resin and employ only a *resin polymerization* mechanism to achieve setting (NO acid base reaction) Not a true Glass Ionomer because no Acid/Base reaction! One category of these is called Compomers

**Resin Modified Glass Ionomers.** The resin-modified materials have been shown to have significantly higher flexural and tensile strengths and lower modulus of elasticity than the conventional glass ionomer materials. They are therefore more fracture-resistant but their wear resistance has not been much improved. In addition, their strength properties are still much inferior to those of composite-resins, and so should not be subject to undue occlusal load unless they are well supported by surrounding tooth structure.

***A special thank you to the Creighton University School of Dentistry, specifically to the Operative Department who helped in my gathering of information for this lecture.***
Results of a pilot study exploring the use of peri-lesional infiltration of recombinant feline interferon omega in refractory cases of feline gingivostomatitis

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The chronic gingivostomatitis complex is an invalidating feline disease, characterized by the development of inflammatory damages affecting some oral cavity zones. The shape the hardest to treat is located at the later zones of the mouth: this is caudal stomatitis. At this time, there is no specific treatment for this disease. The current implemented therapy goes first through a "dental" phase during teeth excisions, plaque support, tries to eliminate the maximum of antigenic sources liable to maintain the inflammation. If removing teeth should be enough in theory to heal inflammations, it is actually needful to practice a quasi-total extraction. Treatments combining antibiotics and corticosteroid therapy are often prescribed, even for life, so as to limit the oral bacterial flora and control the inflammation to allow the animal to feed.

Studies show that the development and the maintenance of the CGSCF is associated in most of chronic infection cases by feline Calicivirus (FCV). It is moreover interesting to note that the quasi-totality of affected cats presenting caudal stomatite disease are FCV chronic carriers.

Considering the antiviral and immunomodulatory properties of the feline omega interferon, this study aims at rating its clinical efficiency and its tolerance in the in situ treatment of the "caudal stomatitis" shape in this complex.

1) The interferon Omega: way of action and interest of the local approach

The interferons type I (α, β and τ) are cytokines produced by almost the whole cells when viral infections occur. They are inherent in the antiviral immunizing answer, and also have properties immunomodulatory and anti-proliferative.

Interferons are naturally produced when viral infections occur. By settling on the cell host of the virus, they provide to the host defense leading the proteins synthesis able to interrupt viral replication. For example, the OAS (2′5′-oligo-oligo Adénilate-synthétase) leads to the viral ARNm destruction, and the PKR (protein kinase p68) pull the inhibition of the viral proteins synthesis. Interferons can also slow down the cellular growth or lead their apoptosis so as to avoid virus progression. The virus replication is then impossible. its proliferation is stopped [1, 2, 3, 4].

At the human stage, an overdose of IFN parenteral administration can have a big toxicity, and also can, in the long term, provoke the antibodies production managed against these IFN. Then, the efficiency of the interferon treatment can be reduced along treatments. The
production of anti-IFN antibodies does not exist following to the oromucosal administrations [7]. An interleukin, IL-10, occurs in this phenomenon called “mucosal tolerance”. That is why the oromucosal approach is the matter of a detailed research.

Mx-protein, one of the proteins inferred by interferons type I, is currently the best marker of their antiviral activity. Indeed, compare to the other proteins inferred by interferons, research of Mx-protein is more sensitive (it is detected in blood after an interferon administration by oral route) and more specifically (it is not inferred by the interferons type II). It was considered for a long time that oral route could not be effective because IFN cannot cross the bowel wall without being digested by digestive enzymes.

Now Mx-protein was detected after oral administration of IFN-omega: indeed, the interferon administration by oromucosal route leads to the Mx-protein in dosis dependant way, and as the same intensity as parenteral route [6, 9]. How can interferons, which do not resist to the digestion by the gastric enzymes, perform in the body when they have been administered by oromucosal route. It would seem like proteins, after mucosal absorption, would stimulate orolingual MALT, such as tonsils) [8]. In these MALT, IFN could then infer the whole cells in the body by induction step by step. Administration by eye route (eye drops) of interferon leads to the same results. Moreover, the Virbagen Oméga efficiency by eye drops in kératites treatment was recently demonstrated [5]. We can think that interferon was able to go into the leukocytes by the (conjonctival mucous membrane) fully vascularized and/or by joining MALT orolingual via nasoantral route.

It is worth noting that interferon would be able of be effective in tonsils during local administration. Indeed, pharyngeal tonsils are located in palatoglossis folds, hangout place for replication of FCV virus during CGSCF. Consequently we chose to treat the CGSCF by interferon omega sub– mucosal injections, directly in inflamed palatoglossis folds.

2) Equipment and method

A try was realized on 8 cats selected without any age distinction, race or sex and negatives towards FIV retrovirus and FeLV.

A) Admission and exclusion criteria

During visits preceding the admission, the candidate cats have systematically underwent oral treatments of first intention: descaling, curettage and polishing of teeth, along this initial therapy, a lesional check-up is settled. Teeth showing snare damages, those situated in ulcer necroted location and those situated on parodontopatic location are extracted. An antibiotic treatment (Clindamycine in 11 mg / kg / day) is administered during 15 days. A revaluation of the toothed and toothless zones is made following this antibiotic treatment to make sure of the complete withdrawal of the dental material (radiological control). If inflammatory damages
persist in the caudal zones of the mouth, a taking by cytobrosse was made to confirm the attendance of Calicivirus (FCV) by PCR technique (Lab. Scanelis Toulouse).

Only cats affected by specific damages of CGSCF in the caudal area of the mouth, after a minimum deadline from 1 to 2 months after the treatments quoted above (i.e. cats in which a caudal stomatitis persists), with a positive search for FCV and negative for in FIV and the FeLV were included in the study.

Thus, animals having received a glucocorticoides injection of by injection or oral route or progestagen in 4 weeks preceding the inclusion, could not participate in the follow-up.

B) Treatment

The substance applied is the interferon associating feline origin Omega to 10 MUI by flask of 1ml, it is diluted with the solvent of origin, some isotonic sodium chloride (1 ml).

Virbagen ® Omega is applied by infiltration under mucous membrane. Under general anesthetic (Domitor ND, 80 in 150 µg / kg IM) the injection is done in the limit between the inflamed areas and the healthy mucous membrane, in a very superficial way until obtaining a papule under mucous membrane. A total dose of 1 MUI is applied upon two sites (one to the right, the other one to the left), then a 0,05 ml volume by infiltration with an insulin syringe and a needle like microlance 25 GA 5 / 8-0,5X16-Luer Lok (orange BD). Before removing the needle after infiltration a soft pressure with a foam spatula is applied by an assistant during some seconds so as to avoid the leak of the product or a possible micro local bleeding. Animals are woken with the AntiSedan, according to the AMM. These infiltrations are three times repeated to two weeks of interval, namely in day 1, day 15 and day 30.

The day of the infiltration, they receive, if their state requires, a unique dose of non steroidal anti-inflammatory drug with Meloxicam (0,3mg / kg sc) so as to reduce the post anesthetic pain. During 7 days following the infiltration they receive an antibiotic treatment (Clindamycine per bone: 11 mg / kg once a day).

None corticoide or immunomodulator substance is administered.

C) Visits schedule

The first visit to day 1 (clinical rating + 1th infiltration) is followed by a visit to day 15 (clinical rating + 2nd infiltration), to day 30 (clinical rating + 3rd infiltration), and in day 60 (clinical rating). In each visit animals are weighed: this element constitutes for us one of the best signs for the food takeover.

D) Score Attribution during the clinical examination

During every consultation, the animal behavior, estimated by the owner, was rated: the appetite, the pain during the feed or during the yawn, the salivation and the activity (games, socialization, releases, hunting). These elements are rated from 0 to 3 according to their intensity.
During the clinical examination, several criteria were rated on the awake cat and converted into scores, always by the same practitioner:

- The area and the intensity of the inflamed damages at the level of gums and caudal areas of the mouth.

- The pain in the opening of the mouth

- The halithosis and/or the modification of the saliva (viscosity)

- The mandibular lymphatic nodes (NL)

During the study, the local and general tolerance of the treatment were checked (nature of the side effects, time limit concerning the administration of the treatment as well as the duration).

Assessment criteria concerning the clinical efficiency are the evolution of the scores of inflammatory damages and the lesional area, as well as the evolution in time of associated clinical evidence, of behavior and the weight score.

3) Results, comments, discussion

- Concerning the weight evolution, which is a pristine indicator to evaluate the evolution of the clinical status and the well-being on 8 tested cats, we notice a weight rise to 5 cats on 8, average weight passing from 4.09 kg to 4.43 kg in 60 days.

- In a general, all scores decrease sharply from day 15 then stabilize until day 60. The most important improvement concerns the well-being and the clinical score, which constitutes the criterion the most important for the owner.

On 8 treated cats, 4 were followed until day 20. For these animals the evolution of the clinical and lesional criteria can come down to the following:

Clinical signs remain stable until 120 days with low scores.

- The caudal stomatitis, which raise up most problems, evolves differently from a cat to another beyond day 60, with a resumption of the damages to one of the cats, a decrease to another and stabilization to the others.

- For all the global orolingual damages (caudal and gingival) the scores decrease observed in day 60 remains slightly until day 120 but for a cat, which we observe a global resumption of the global inflammatory indexes scores.

- the well-being signs in which we include the appetite, the pain while feeding and the activity remain stable as regard to those noticed on day 60.
The relevant aspect of this pilot study from the point of view of the clinical and the lesional balance is an improvement of all the scores. Thus, the weight, the well-being and the clinic are improved, the caudal stomatitis damages fin decrease in size and in intensity. If gingival damages decrease in intensity, they still could be more eased by dental extractions.

Concerning tolerance this study required the interruption of the protocol to none of the 8 cats.

More detailed discussion:

On the other hand some of these animals were revised after the end of the study and the follow-up of these cats on the long term shows a slow but regular resumption of the orolingual problems on at least half of the cats. This observation makes us think about the frequency of the local injections in this pilot study which was of course arbitrary and rather based on convenient consideration (no need to anesthetize these animals in a too close-range time).

. We can deduce that new protocols including easier administration (following or not local infiltrations) will be studied and will be the object of later clinical studies so as to show the efficiency of a daily administration on prolonged durations.

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Controlled study using a modified 2x2 cross-over design to compare the efficacy of recombinant feline interferon omega and prednisolone in refractory feline chronic gingivostomatitis

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Introduction:

Feline Chronic Gingivostomatitis (FCGS) cases which are refractory to dental extractions are frustrating and difficult to manage. As type-1 interferons are both antiviral and immunomodulatory, promoting a return to an appropriate Th1 profile, it becomes interesting to investigate the beneficial potential of recombinant feline interferon omega (reFeIFN-ω) in these cases.

Method:

This multicenter randomised open label study recruited 23 cats (5 were eventually excluded) and compared the effects of subcutaneous reFeIFN-ω with oral prednisolone. After a 2 month period, cats with a satisfactory response to their initially allocated treatment were given a second sequence of the same. Cats without a satisfactory response were changed to the alternative treatment. Animals were assessed every fortnight. Specific lesional parameters such as severity of inflammation and lesion area, as well as secondary clinical parameters, were assessed numerically and analysed statistically.

Results:

9/9 cats in the prednisolone group moved to reFeIFN-ω for the second sequence, while 5/12 cats in the interferon group moved to prednisolone (p=0.0071). In the interferon group there were significant decreases in area (p=0.0075) and inflammatory severity (p=0.0277) of faucitis. The mean total clinical score decreased in both groups during the first sequence with no statistical difference between groups.
Comparative Efficacy Of A Recombinant Feline Interferon Omega In Refractory Cases Of Calicivirus-Positive Cats With Caudal Stomatitis: A Randomized, Multicentric, Controlled, Double-Blind Study In 39 Cats

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Introduction
Feline Chronic GingivoStomatis (FCGS) characterized by ulcerative / ulceroproliferative caudal stomatitis and alveolar mucositis is an ill-defined frustrating multifactorial condition. Chronic oral carriage of Calicivirus is commonly associated with these lesions. Though dental extractions may lead to clinical cure of 60% of cats, adjunct treatments are often needed and corticosteroids are commonly used. Recently, recombinant feline interferon omega (ReFeIFN-w) has been marketed and its use for the treatment of cats refractory to dental extractions has been proposed.

Method
In this multicentric study, we recruited 39 cats suffering from FCGS with chronic caudal stomatitis which were refractory to dental extraction treatment performed 2 or more months earlier. These cats were blindly and randomly allocated into two groups: oromucosal administration of ReFeIFN + placebo tablets / oromucosal administration of placebo + prednisolone tablets. Cats were observed during a 90-day period on D0, D15, D30, D60 and D90. When possible, cat condition was checked by phone call on D120. Related clinical signs, severity of inflammation in alveolar mucositis and caudal stomatitis lesions, and also area of caudal stomatitis were evaluated using numerical scores. Statistical analyses were performed.

Results
An overall tendency of improvement for related clinical signs was observed in both treatment groups between D0 and D90. The mean score of pain on opening cat’s mouth was lower in the Interferon group on D60 and D90 (p=0.017 and p=0.007, respectively).

A continuous and steady improvement was observed for caudal stomatitis and for area of the caudal stomatitis lesions in both treatment groups. A significant decrease of scores compared to D0 was shown in the Interferon group, from D30 to D90 for area of the caudal stomatitis lesions (0.01≤ p≤0.03), and on all time points for caudal stomatitis and buccostomatitis (0.001≤ p≤0.01 and 0.002≤ p≤0.01, respectively).
Eight cats (33.3%) in the Interferon group versus 9 cats (60.0%) in the Prednisolone group needed rescue medication (Antibiotics, NSAIDs, Opioids) during the course of the study. Differences between treatment groups were however not significant.

Complete cure and marked improvement occurred in 45% of cats in the Interferon group and in 23% of cats in the Prednisolone group when assessment was made by investigators, and in 39% of cats in the Interferon group and in 23% of cats in the Prednisolone group when assessment was made by owners. These differences were however not significant.

**Discussion**

Cat with FCGS and presenting with bilateral ulcerative or ulcero-proliferative caudal stomatitis are very challenging to treat. An association has been shown between caudal stomatitis and chronic calicivirus carriage but no clear cause to effect relationship has been shown. Nevertheless, dental extractions has been shown to be the most effective treatment for this cats. By removing infectious/inflammatory processes and chronic antigenic stimulation, extractions may enable local bodyâ€™s defenses to better act. However, about 20% of the cats are not or insufficiently improved and are often treated with glucocorticoids in order to enable them to eat. The overall results of this study have shown that refractory cases of FCGS with caudal stomatitis can be managed with oromucosal applications of ReFeIFN-w (Virbagen-omegaÂ®).

**Conclusion**

Oromucosal application of ReFeIFN-w (Virbagen-omegaÂ®) is a viable alternative to glucocorticoids for refractory cases of FCGS with caudal stomatitis not improved by dental extraction. This treatments lacks the disadvantages of corticosteroids and might be more effective when considering treatment evaluation as reported by the practitioners and the owners, though insufficient statistical power was not able to show superiority in this study. Considering the encouraging results of this study, the use of this protocol earlier in the disease process might be considered but further studies would be necessary to fully evaluate its effect.

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Acute Necrotizing Ulcerative Gingivitis?

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Introduction

Gingivitis is defined as reversible plaque induced inflammation limited to the gingiva. Acute necrotizing ulcerative gingivitis, also known as trench mouth, Vincent’s stomatitis, is defined as ulcerative lesions covered with gray necrotic debris that often bleed and cause discomfort. Necrotizing gingivitis is known to affect debilitated and immune compromised patients suffering from stress or FeLV, FIV and is known to be caused by fusiform and or spirochete bacteria.

Method

This case report relates to the findings of three different juvenile cats who were affected with necrotising gingivitis and osteomyelitis. Gingiva and bone tissue were sent to the laboratory for microbiology culture and sensitivity tests. The cats were treated with debridement of the necrotic tissue, rinses, appropriate antibiotic and oral mouth gel.

Results

All three cases showed a healing process within a few months of treatment including home care with antibiotics and gel placement. Two out of the three cats were negative to FeLV, FIV and Calici Virus. The bacteria isolated was E.coli and Proteus mirabilis in two out of three cases and Klebsiela pneumonia and Prevotella species in one out of three cases.

Discussion

Issues to be discussed in this presentation will relate to the definition of necrotic gingivitis/osteomyelitis, type of bacteria found, the viral status of the patients and the treatment outcome.

Conclusion

It seems that there are more kittens suffering from this entity in Israel than is thought. Viruses may not be the main cause but rather a debilitating immune status at a very young age. Necrotising ulcerative gingivitis may not be the proper definition for this clinical entity, osteomielitis may be a better definition.
Real-time PCR quantification of Feline Calicivirus: prospective study on 20 cases of feline caudal stomatitis.

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Introduction

The interest of Feline Calicivirus (FCV) PCR testing has been widely reported in case of feline caudal stomatitis. In this preliminary study we have tried to elucidate several points which have remained unclear to date:

- Viral load variation between samples collected at different sites (jugal/caudal)
- Significance of absolute viral load quantification: need of normalisation?
- Correlation between clinical scoring and quantitative PCR results

Jugal and caudal samples were collected from 20 cats with caudal stomatitis and/or acute oral inflammations such as buccostomatitis and aggressive periodontitis. For each site, sampling was focused on the most affected area. Inflammation score and surface score have been determined for each animal at the collection time. Feline calicivirus quantitative real-time PCR analyses were performed by Scanelis.

PCR Results

FCV PCR was positive for 18 out of 20 cats. For each positive cat, both jugal and caudal samples were positive.

Results showed a range of absolute viral loads from $10^5$ to $10^9$ viral genomes per sample. Comparative analysis of absolute viral loads from jugal and caudal sites demonstrated a 0.1 to 10 ratio (jugal/caudal). The jugal absolute viral load is higher than the caudal one in 10 cats out of 18.

The cell count ranged from $10^5$ to $10^9$ cells per sample. Comparative analysis of the cell count from jugal and caudal samples demonstrated a 0.01 to 30 ratio. A higher cell count was generally measured in caudal samples than in jugal ones.

Normalised viral loads have been calculated (absolute viral load/cell count). Values ranged from 0.01 to 100. Comparative analysis of normalised viral loads from jugal and caudal sites demonstrated a 0.1 to 40 ratio (jugal/caudal). The jugal normalised viral load is higher than the caudal one in 70% of the cats.
Clinical scoring

Inflammation score and surface score have been evaluated for both jugal and caudal sites. Inflammations score was measured after a gentle finger pressure on the affected area and ranged from 0 to 3 as follow:

- IS 3/“Spontaneous bleeding”
- IS 2/”Delayed bleeding”
- IS1/“No bleeding”
- IS0/”No inflammation”

Surface score has been defined as the ratio of affected surface/total clinical surface and ranged from 0 to 4 as follows:

- SS 4/ 100%
- SS 3/ < 75%
- SS 2/ < 50%
- SS 1/ < 25 %
- SS 0/ No inflammation

Buccostomatitis was reported on 18 cats out of 20. Caudal stomatitis was reported on 14 cats out of 20. Aggressive periodontitis was reported on 13 cats out of 20.

Caudal stomatitis was associated with aggressive periodontitis in 50 % of the cases and vice versa.

Two cats were negative for FCV PCR testing. The first one presented only an aggressive periodontitis whereas the other one presented only a buccostomatitis.

Results of IS ranged from 0 to 3 and the sum of jugal and caudal IS ranged from 0 to 6. Results of SS ranged from 0 to 4 and the sum of jugal and caudal SS ranged from 0 to 8.

The difference between jugal and caudal IS ranged from -1 to +2. Difference between jugal and caudal SS ranged from -2 to +3.

The different clinical scores and PCR data were analysed but these preliminary results didn’t allow establishing any correlation.
Conclusion

Whereas absolute viral loads were similar in jugal and caudal samples, normalised viral loads seemed to be higher in jugal samples. Indeed cell counts were higher in caudal samples, which may reflect the sample quality. However a severe necrosis yields a lot of cellular debris which could lead to an artificially increased cell count.

Clinical distribution (jugal/caudal) of acute inflammatory lesions (buccostomatitis, caudal stomatitis, and aggressive periodontitis) didn’t appear to affect the viral load and the inflammatory scores.

No significant correlation has been established between the clinical scores and the feline calicivirus viral load.

Further investigations are necessary to evaluate more accurately the interest of normalised PCR results.
Dental techniques in marine Mammals

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Veterinary Dental Procedures can be successfully performed on Marine Mammals and this presentation will discuss five procedures in four different species. Due to the anatomical and physiological adaptations to sea life marine mammal anesthesia has its own set of complications. As a result, handlers and marine mammal veterinarians are very leery about anesthetizing them. In addition, there is a different willingness to cooperate among the different species and individuals. This makes oral care very difficult.

An adult male sea otter (Enhydra lutris) was evaluated for a fractured left mandibular canine tooth. Sea otters are the only member of the family Mustelidae that lives only in the marine environment. This animal was one that had previously been rescued and set loose. While it could survive in the wild, it had not developed necessary sea otter social skills and developed necrophilia. When this happens, male sea otters will frequently kill sea lion pups. As a result, the animal was recaptured and placed in a research environment where it could no longer harm other animals. When and where the teeth were broken is unknown. The dental formula is 2x (I 3/2, C 1/1, PM 3/3, M 1/2).2 The behaviour and dentition of the Sea Otter have been adapted to feeding on tough foods like shells, octopus, and other invertebrates. They therefore are bunodont (flat dentition for crushing).3 This sea otter, as in most other sea otters, can only be effectively examined under general anaesthesia. Anesthesia was induced with Fentanyl and Midazolam and maintained with Isoflurane and oxygen. Treatment consisted of intraoral dental radiographs and endodontic therapy for the fractured canine tooth and exodontia of fractured incisors.

An adult female California sea lion (Zalophus californianus) was evaluated for a fractured left mandibular third premolar. The patient did not exhibit any clinical signs. The dental formula is 2x (I3/2, C1/1, PC 5-6/5). The premolars and molars in the Pinnipeds are so similar that they are just called â€œpost canines.â€ However, they can be developmentally divided into 4 maxillary and mandibular premolars and 1 or 2 maxillary molars and 1 mandibular molar.4 Several diagnostic and therapeutic procedures were performed while the patient was awake. The patient was trained to accept a protective lexan cover for the sensor. After the trainers positioned the cover and sensor, the patient was instructed to hold her nose against a target poll. The first was a intraoral radiographic evaluation using a size 2 digital radiographic sensor. This radiograph indicated a fractured tooth with lytic bone around the root. The patient was subsequently trained to accept a local anaesthetic. Intraligamental anaesthetic with 0.5% bupivacaine hydrochloride was administered by progressive infiltration with a N-Tralig Intraligamentary Syringe, and the tooth was extracted by elevation technique. This exceptionally well trained patient allowed extraction without any complication. In a second procedure, additional teeth were extracted under general anesthesia. This points out the need for full mouth radiographs in this species as well as others.
An adult male Oriental Small-clawed Otter (Aonyx cinerea) was evaluated for a fractured left maxillary canine tooth. This Otter is a freshwater otter that mainly feeds on invertebrates. After induction of anaesthesia with ketamine and medetomidine and maintenance with Isoflurane, a complete oral exam including intraoral radiology was performed. In addition to the fractured canine, the right mandibular third premolar was fractured. Root canal therapy was performed on the canine tooth. Due to the length of time prior to treatment and progression of disease of the premolar, the premolar was extracted. Had the condition been addressed earlier, endodontic treatment and restoration would have required less time under anaesthesia than extraction.

An adult female Northern Elephant Seal (Mirounga angustirostris) was evaluated for a fractured left maxillary canine tooth. The dental formula for the Elephant Seal is 2 x (I2/1, C1/1, PC 4/4, M 1/1). A fistula was present and was non-responsive to daily irrigation with first betadine and later dilute chlorhexidine solution. After induction of anesthesia with Telezol, and incremental doses of ketamine, anesthesia was maintained with Isoflurane. The tooth was extracted by first extracting the first premolar for access then elevated using specially adapted tools shaped to be dental elevators. The fistula closed up, and healed without complication. 7 years later, the patient developed a stomatitis that was caused by a gammaherpesvirus.

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Surgical Endodontics Performed On A 6-Year Old Alpaca

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Conventional endodontic procedures in herbivores are rather impossible to perform due to the small oral opening combined with the extreme length of the mandible. This case report details step-by-step procedures for surgical endodontics on herbivores, where the only viable approach to endodontic disease is by retrograde.

Surgical endodontics has been performed on posterior dentition to a degree in equines, but to my knowledge this is one of the first surgical procedures for posterior dentition on alpacas.
Impact Of Pelleted Diet Of Different Mineral Composition On The Size Of Mandibular Premolars And First Molars In Degus (Octodon Degu)

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Introduction
As a result of the increasing numbers of guinea pigs, chinchillas and other small rodents being kept as private pets, dental disease is being observed more frequently in veterinary clinics. Incidence of oral cavity diseases is approximately 30-80%, with variables among species (Jekl 2008). A wide range of local and systemic conditions that affect the mouth and oral cavity has been described in herbivorous rodents, including infectious and metabolic diseases, trauma, electric accidents and neoplasia (Crossley and Aiken 2003, Legendre 2003). This report presents a preliminary survey about the impact of pelleted diet with different mineral composition on the size of mandibular premolars and first molars in degus (Octodon degu).

Materials and Method
Male degus were housed in plastic and wire-mesh cages in the animal care facility with controlled conditions (day light 12/12 hours, temperature 20-23 °C, humidity 41-51%). The degus were fed twice a day by complete pelleted diet and had free access to water. A total of 28 animals were randomly divided into 4 equal groups fed by different mineral content with different access to UV-light per 12 hours a day (Table 1) from the age of 12 weeks. Nutrition content, fibre included, was similar in both types of diets. The animals were housed and handled with the agreement of the Branch Commission for Animal Welfare of the Ministry of Agriculture of the Czech Republic. The animals were clinically examined regularly and euthanised at the age of 17 months. Oral cavity was thoroughly examined using rigid endoscope as described by Jekl and Knotek (2007).

Conventional skull radiographs were performed in two standard views â€“ ventrodorsal and right lateral. Length and width of skull and mandible were measured. Dental radiographs of right mandible were performed in all animals and the size of one premolar (408) and the first molar (409) was recorded. The reserve crown (whole tooth) of particular tooth was measured at three different positions â€“ mesial, middle and distal (Figure 1) in millimetres. Tooth curvature was followed to achieve the exact data in all measurements. Because of relatively small numbers of experimental animals in respective groups, the one-tail Mann-Whitney non-parametric test was used for statistical analysis. Differences with the value P<0.05 were considered statistically significant. All calculations were performed with MS-Excel® (Microsoft Corp., Inc.) and Prism® (Graph Pad Software, Inc.) software.
Results
No significant changes were recorded when comparing the skull and mandibular length and width. Dental disease developed quickly in groups C and D. First signs of dental disease were represented by incisor depigmentation which was seen in all animals in group C and D as soon as three weeks after initial feeding the high phosphorus diet. Animals from group C and D had also obvious signs of dental disease with incisor and cheek teeth elongation resulting in anorexia and weight loss. Coronal elongation of mandibular cheek teeth were seen by endoscope and apical teeth elongations were easily palpable on the ventral mandibular surface. Dental radiographs of right mandibula confirmed particular reserve crowns elongation in both, coronal and apical directions (Table 2). Highly significant elongation (P<0.001) of premolars and first mandibular molars was recorded in group D when compared with group A and B. Significant reserve crown elongation of both teeth was also recorded in group C when compared with group A (P<0.05) and group B (P<0.01). There were no significant changes when comparing teeth size in group A and B and in group C and D respectively. Premolars and first molars of degus from group C were smaller in size in comparison to group D; however it was not statistically significant.

Discussion
Free ranging degus ingest mainly herbaceous foliage and seed of shrubs. In comparison to other rodents degus consume more than 200 g crude fiber per kg of dry matter and ingest plants containing silicon which is highly abrasive (Bozinovic et al. 1997). In captivity, good quality timothy hay, specific degu commercial feed, leafy vegetables and dried herb mix are recommended (Long 2010). Little information on the mineral requirements of Octodon is published, so dietary guidelines should be based on those recommended for rats (calcium 8.5 g/kg, phosphorus â€“ 5.1 mg/kg, Edwards 2009) or other hystricomorphs (guinea pigs â€“ calcium 8 g/kg, phosphorus â€“ 4 mg/kg, National Research Council 1995). However, mineral composition in commercially rodent diets is not available. Moreover, degus are selective feeders (Gutiérrez and Bozinovic 1998), so proper determination of mineral composition is hard to determine. In this study, degus were fed only pelleted diet and no any other food was added to achieve proper input data and to minimise the potential differences between particular animal groups.

In pet rabbits and herbivorous rodents with elodont dentition the most common theories promoted for the cause of dental disease are genetic/inheritance factors, lack of abrasive diet (Crossley 1995) and underlying metabolic disease due to calcium and/or vitamin D deficiency (Harcourt-Brown 2007). Hereditary dental disease (mandibular prognathicism) was confirmed in rabbits (Lindsey and Fox 1994), but there are no references regarding hereditary dental/jaw diseases in degus. Diets provided to captive small mammals rarely match those in free ranging animals, being higher in energy and nutrient content, lower in fibre and having less abrasive properties (Wolf et al. 1997). This leads to improper mastication patterns and lack of tooth wear resulting in continued eruption and abnormal incisor and cheek teeth reserve crown elongation (Crossley 2005).

The present study shows that diet with improper mineral content, particularly high phosphorus diet, led quickly to dental disease. Dental disease in group C and D was so severe, that animals had to be euthanised from ethical reasons earlier than expected. Degus from group A
and B developed only early stage dental disease presenting apical cheek teeth elongation, which could be caused by diet with unproper abrasive properties. Controlled studies to determine vitamin D requirements have not yet been reported (Edwards 2009). However, in this study there were some differences in reserve crown size. Premolars and first molars of degus on high phosphorus diet which were exposed to UV light were smaller in size in comparison to teeth of animals on high phosphorus diet and no excess to UV light, however it was not statistically significant. Further studies should be done to prove the effect of UV light on calcium metabolism in this species.

Conclusion
The present study demonstrates that unproper dietary content of calcium and phosphorus has deteriorative effect on degus dentition. It also illustrates that unproper dietary calcium and phosphorus level and its unproper ratio is responsible for rapid development of dental disease in degus with subsequent severe health impairment.

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Table 1 Mineral dietary content and access to UV light in respective animal groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Diet</th>
<th>Access to UV-light</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Ca 13.2 g/kg, P 6.3 g/kg</td>
<td>YES</td>
</tr>
<tr>
<td>B</td>
<td>Ca 13.2 g/kg, P 6.3 g/kg</td>
<td>NO</td>
</tr>
<tr>
<td>C</td>
<td>Ca 9.1 g/kg, P 9.5 g/kg</td>
<td>YES</td>
</tr>
<tr>
<td>D</td>
<td>Ca 9.1 g/kg, P 9.5 g/kg</td>
<td>NO</td>
</tr>
</tbody>
</table>

Table 2 Reserve crown size of right mandibular premolar and first molar measured in three different positions (mesial, central and distal) recorded from dental radiographs of right mandibula. Data are expressed in millimetres as mean ± S.D.

<table>
<thead>
<tr>
<th>Group</th>
<th>P4 - reserve crown size</th>
<th>M1 - reserve crown size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mesial</td>
<td>central</td>
</tr>
<tr>
<td>A</td>
<td>8.7±0.52</td>
<td>9.3±0.54</td>
</tr>
<tr>
<td>B</td>
<td>8.0±0.48</td>
<td>8.5±0.62</td>
</tr>
<tr>
<td>C</td>
<td>9.4±1.26</td>
<td>9.8±0.78</td>
</tr>
<tr>
<td>D</td>
<td>10.2±0.68</td>
<td>10.9±0.59</td>
</tr>
</tbody>
</table>

Figure 1: Measurements of the reserve crown (408) were done in three different positions mesial, middle and distal.
Long-term effect of diet on mandibular and cheek teeth density in degus (Octodon degu) – preliminary study

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Introduction

Metabolic bone disorders remain a frequently diagnosed condition in reptiles, and it is also seen in other exotic animals, such as non-human primates and zoo animals that have been improperly fed and maintained (Knotek et al. 2003, Fowler and Miller 2008). The most frequently observed metabolic bone disease is nutritional secondary hyperparathyroidism (NSHP) which leads to extensive osteoclastic resorption of bone and formation of fibro-osseous tissue, caused by the prolonged and excessive secretion of parathyroid hormone. The common causes of NSHP are deficiencies of dietary calcium and/or vitamin D and excess dietary phosphorus, each of which could cause hypocalcaemia (Palmer 1993).

In small companion mammals it is suggested that dental disease in rabbits is caused by calcium and/or vitamin D deficiency which lead to loss of supporting alveolar bone and allow apical elongation (Harcourt-Brown 2009).

This report presents a preliminary survey about the impact of pelleted diet with different mineral composition on the mandibula and mandibular cheek teeth density in degus (Octodon degu).

Materials and Method

Male degus were housed in plastic and wire-mesh cages in the animal care facility with controlled conditions (day light 12/12 hours, temperature 20-23 °C, humidity 41-51%). The degus were fed twice a day by complete pelleted diet and had free access to water. A total of 28 animals were randomly divided into 4 equal groups fed by different mineral content with different access to UV-light per 12 hours a day (Table 1) from the age of 12 weeks. Nutrition content, fibre included, was similar in both types of diets. The animals were housed and handled with the agreement of the Branch Commission for Animal Welfare of the Ministry of Agriculture of the Czech Republic. The animals were clinically examined regularly and euthanised at the age of 17 months.

CT examination was performed on each degu using a Siemens Somatom emotion multislice scanner. For the purpose of this study left mandibula images were reconstructed in oblique sagital planes where all the cheek teeth were sectioned in midline and most cheek teeth were seen on one image. Hounsfield units (HU), which characterise the relative tissue density, were
measured in all animals at six different positions (Figure 1) using a round region of interest (ROI). CT densitometry was performed by only one observer to minimize the subjective faults.

Because of relatively small numbers of experimental animals in respective groups, the one-tail Mann-Whitney non-parametric test was used for statistical analysis of HU density data. Differences with the value P<0.01 were considered statistically significant. All calculations were performed with MS-Excel® (Microsoft Corp., Inc.) and Prism® (Graph Pad Software, Inc.) software.

**Results**

Dental disease with obvious apical and coronal elongation of all teeth was evident in groups C and D. However, apical elongation was also recorded in group A and B. The Hounsfield Units (HU) of all compared regions of group A and B, as well as group C and D respectively, were not significantly different (Table 2). When comparing group A and C, significant increase in density were seen in group A for position M3, JAW INC, JAW P4-M1 and TOTAL count of HU units. Group A and B had a higher density for position JAW P4-M1 and TOTAL count of HU units then group D. Significant increase in bone density was recorded in all particular regions of group B when compared with group C.

**Discussion**

This is the first study to introduce an objective quantitative method for the evaluation of the relative density of particular mandibular and cheek teeth regions in degus fed by a diet with different mineral content and with different UV light access. Significant differences between bone/tooth densities were seen when comparing group B and C. However, significant higher relative bone densities for regions JAW P4 and TOTAL were recorded also in all groups fed by diet with proper calcium to phosphorus ratio when compared with degus fed by high phosphorus diet and there were no obvious differences when being exposed to UV light or not. As the animals in group A and B developed early stage of dental disease and as the diet was different to that in nature, authors can not assume that densities of group B and C are physiological.

In general, the structural formation of the bone will appear in a proper way to withstand the feeding forces, while the quantity of bone tissue will be as less as needed for its functional requirement. Part of the structural pressures encountered during mastication is transferred to other parts of the jaws and skull along paths of stress (Wiggs and Lobprise 1997). Degus as other animals with continuously erupting teeth (completely elodont dentition) seem to be very sensitive to intrusive occlusal forces, which cause apical resorption with subsequent apical elongation as was suggested by Crossley (1995). This study showed that decreased relative bone density due to nutritive mineral imbalance enhanced development of dental disease and intensified apical bone resorptive process.

Additionally the authors suggest that changes in cheek teeth relative density and subsequent deterioration of tooth quality were caused by unproper function of tooth germinal tissue, but
this theory must be confirmed by histopathological examination. This study also shows that no dietary calcium deficiency per se, but high phosphorus and improper calcium to phosphorus ratio could cause or at least enhance severe dental disease.

**Conclusion**

The present study demonstrates that improper dietary content of calcium and phosphorus has deteriorative effect on degus dentition and mandibular bone density. Significantly higher relative cheek teeth and bone densities in CT were recorded in degus fed by diet with proper calcium to phosphorus ratio when compared with animals fed by high phosphorus diet. There were no obvious differences if they were exposed to UV light or not. This study shows that high dietary phosphorus and improper calcium to phosphorus ratio could cause or at least enhance severe dental disease.

**Acknowledgements**

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**References**


GENETIC SUSCEPTIBILITY TO PERIODONTAL DISEASE IN DOG: ASSOCIATION ANALYSIS OF NEW GENETIC VARIATIONS IN LTF GENE

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Introduction

Periodontal Disease (PD) includes inflammatory diseases induced by bacterial plaque in the periodontium. Initially, it is manifested in the form of gingivitis and can progress to a chronic inflammatory form called periodontitis (Kinane and Hart, 2003; Niemiec, 2008). The origin and modulation is mainly associated to microbial and environmental factors, however, it presents a multifactorial aetiology, in which behavioural, systemic and genetic factors are described (Taylor et al., 2004; Meng et al., 2007). The importance of PD in human medicine is clear and it is estimated that 30% of the adult population is affected (Nares, 2003). In veterinary medicine, the PD is also very important, being the most common disease of the oral cavity in domestic carnivores, about 70% of cats and 80% of dogs already have some degree of PD at two years old (Wiggs and Lobprise, 1997). Furthermore, the PD has been associated with other systemic diseases, a factor that has contributed to raise the interest in the investigation of factors related to its development. Many agents and/or mediators involved in PD remain unclear, being necessary to develop new research to analyse them. Its early identification may help to establish profiles of susceptibility, allowing the characterization of individuals with a higher predisposition to the disease and develop more efficient preventive strategies and personalized therapies (Kinane et al., 2005; Yoshie et al., 2007). The molecular
and genetic research has contributed to a better understanding of PD and has shown that many genes play a role in the predisposition and progression of PD, primarily through the regulation of inflammatory mediators (Kinane and Hart, 2003; Meng et al., 2007).

Several animal models have been used in periodontal research in order to study and clarify the aetiology, pathogenesis, microbiological, clinical and immunological factors of PD (Weinberg e Bral, 1999). However, there is not an animal model for investigation on the genetic factors, being these studies performed, mainly, in humans. The characterization of an animal model which allows the investigation of genetic factors associated to PD will facilitate the study and understanding of the disease. The dog is a classically accepted model in periodontology due to the similarities between dog and human disease in terms of pathophysiology and aetiology, however its valence for the study of genetic factors has never been analysed.

This work carried out a molecular analysis of lactotransferrin (LTF) gene in dog, to identify genetic variations and verify its association with PD in a case-control study. Previous research showed that variations in the LTF gene were associated with changes in anti-microbial functions of this molecule, influencing the susceptibility to the disease (Velliyagounder et al., 2003)

**Materials and Methods**

This work analyzed a population of 70 dogs. All animals were subjected to a general clinical exam and an odonto-stomatological evaluation to ascertain the presence or absence of PD and determine its degree. During these procedures, the animals were under effect of general anaesthesia, and met all the standards of animal welfare. After examination, we collected blood samples from all animals. In order to continue this investigation, we first organized a database that included clinical information and biological materials of all animals.

We analysed three regions of the LTF gene and selected specific primers for their amplification by PCR using DNA extracted successfully from figurative elements of the blood with QuickGene DNA whole blood kit S (DB-S) (Fujifilm). PCR conditions were optimized using the DreamTaq PCR Master Mix kit (Fermentas). All amplified fragments were sequenced at Centre National de Génotypage, France.

The frequencies of all variations identified were analysed in a case-control study comprising a population of 70 animals, divided into a control group (45 dogs) and a group of cases with PD (25 dogs), to assess their influence on susceptibility to disease. Statistical analysis was performed with SPSS (Statistical Package for Social Sciences, version 17.0) software.

**Results**

The analysis of sequencing results allowed the identification of eight new genetic variations (Table 1) in the LTF gene.
For all the genetic variations identified, the results showed no statistically significant differences between the control group and the group of cases with PD (Table 2), and no association between the genetic variation and the susceptibility to PD was established.

**Discussion**

The lactotransferrin (LTF) is an iron-binding protein (Fine et al., 2002) and presents in its constitution a cationic peptide designated lactoferricin, which can damage the external membrane of the gram-negative bacteria (Bellamy et al., 1992; Ellison et al., 1988). The reduced capacity to iron-binding of this molecule appears to influence the induction of PD by the bacteria *Actinobacillus actinomycetemcomitans* (Fine et al., 2002). Genetic variations affecting anti-microbial properties of LTF may influence susceptibility to diseases such as PD, where the microbiota is a major predisposing factor (Jordan et al., 2005). In human PD there are some studies that analysed the influence of polymorphic variations in exon 1 of the *LTF* gene with the disease (Velliyagounder et al., 2003; Jordan et al., 2005; Wu et al., 2009). However, these reports provided some controversial results and were performed in different ethnic groups, prompting them all to the need for further studies to clarify the function of this gene in susceptibility to PD.

Although some studies showed that the major periodontopathogenic bacteria differ between human and dog (Genco et al., 1998; Hardham et al., 2005), bacteria such as *A. actinomycetemcomitans* appears in periodontal microbiota of dogs (Nishiyama et al., 2007). Therefore, variations in the *LTF* gene may have a similar effect to that seen in humans. In this work we identified eight new genetic variations in the *LTF* gene in the dog. Analysing the variations previous described stand out the L/15_g.482G>A, L/15_g.445A>G and L/15_g.414A>G by their frequency in the population studied, however only the L/15_g.482G>A influence the encoded amino acid, resulting in the change of glutamic acid to lysine. The variations L/15_g.441C>T and L/15_g.420G>A come up with a very low frequency, however influence the encoded amino acid, the first resulting in the change of proline to leucine, and the second the change of arginine to lysine. The variations located in an intron region (L/2_g.288T>G, L/2_g.403G>A and L/15_g.213C>T) may influence the susceptibility to develop PD if it affects the normal mechanisms of RNA splicing and originates LTF alternative transcripts. After statistical analysis, no genetic variation was associated with susceptibility to PD in dogs, however the population analysed is rather small compared to similar studies performed in humans. This factor may influence the results. As in human ethnic groups, some polymorphisms identified may have a variable effect in different breeds in dog. In the present work we did not evaluate a particular breed, but it will be important to develop studies in this direction, since there is evidence that some breeds (toy, brachycephalic dogs, Maltese terriers, Schnauzers and some variants of Greyhounds) are more prone to develop PD (Dogan, 2007; Klein, 2008).

In human PD there are several genes associated with predisposition to disease, which appears to be an interaction between different polymorphic loci (Meng et al., 2007; Yoshie et al., 2007). In the present work we did not found the association of an individual variation to PD in
the dog, however some of them might be involved in a more complex form, such as in humans. It is important to develop new investigations to assess if some of the genetic variations described in this study can interact among themselves and with other genes, influencing the structure and function of proteins. There is no information at this level for the \textit{LTF} gene in dogs.

Conclusions

This is the first study with the focus on the dog’s PD genetic characterization. In this work it was not possible to associate the genetic variations described with the predisposition to develop PD. It is important to develop new studies to clarify the role of the genetic variants identified in this investigation, involving larger populations. Further studies should be performed to assess the true potential of the dog as an animal model for studying the genetic component of human PD. The analysis of haplotypes may be one of the next steps in order to assess the interactions between these and other variations. It is essential to develop research to identify candidate genes, for example through the analysis of gene expression using microarrays. Based on these studies candidate genes can be highlighted for further analysis of genetic variations. This will allow us to infer the true potential of this animal model, which has proved essential in other areas of periodontology research.

This study was developed under a project involving a multidisciplinary research team in order to characterize the genetic component of PD in the dog. With the continuation of this research we intend to clarify the role of the \textit{LTF} gene and other candidate genes on the susceptibility to PD.

References


Techniques to correct mesially displaced maxillary canine teeth and the complications associated with the orthodontic treatment

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Introduction
Severely mesially displaced maxillary canine teeth, also referred to as “lance canines” canine teeth, are encountered mostly in Shetland Shepherds. A few other breeds such as Italian Greyhounds, Mini Schnauzers, Fox Terriers and some cats can sometimes exhibit this condition. Upon presentation, one maxillary canine tooth is erupting dorsal to the cervix of the ipsilateral third incisor. The crown is pointing straight forward like the lance of a mounted knight. In some rarer instances, both maxillary canine teeth may be affected or the deciduous canine may still be present in the correct position. Correction of this condition requires orthodontic movement or extraction of the misplaced tooth. If left untreated, the mesioversed canine tooth and the adjacent dentition are predisposed to periodontal disease due to crowding. Additionally, the tooth may be in a position of traumatic occlusion with the opposing mandibular canine tooth leading to concussive pulpitis associated pain, and possible pulp necrosis.

Certainly, the orthodontic movement is the better choice as the patient maintains its teeth in a normal occlusion and a strategic canine tooth is not lost. Extraction is much more invasive to the patient. It often results in the formation of an oronasal fistula due to the abnormal position of the root in/near the nasal cavity.

Prior to orthodontically moving teeth, it must be determined that sufficient space and adequate anchorage are available. The client needs to be committed enough to maintain daily hygiene and to come back for timely monitoring visits. The patient must be compliant with the appliance and daily cleanings, and be medically stable for multiple anesthetic procedures. We shall now review the technique to move the “lance canine and how to correct the possible complications that may be encountered during treatment.

Technique
The teeth to be moved and the ones serving as anchor must be radiographed to ensure that their root systems are mature and healthy enough to withstand the treatment without undue damage. Commonly, the maxillary fourth premolars (108, 208) and the first molars (109, 209) are used as anchors. All affected teeth are cleaned with non-fluoridated and glycerin free flour pumice and etched with phosphoric acid according to manufacturer's recommendations. Using an orthodontic bonding agent or a dual cure bonding agent, a lingual button is affixed to the mesiobuccal cusp of the maxillary first molar. Next, a maxillary central incisor bracket, with its base slightly bent to better follow the contour of the mesial cusp of the maxillary fourth premolar, is bonded in place. The base of the bracket is bent using a tri prong pliers, to better conform to the cusp. A length of orthodontic bracket tie wire is then twisted from the lingual button to the distal prongs of the bracket. The twisted end is
cut short and tucked in between the distal prongs in such a way that there is no irritation to the patient. Another alternative is to place a figure-8 24 or 26 gauge wire around the 08 and 09 and cover it with flowable composite to create one anchorage unit. The ends of the wire are twisted and bent into a hook at the mesio-buccal corner of the 08. However, careful placement is needed so that the periodontium is minimally compromised. Having the first molar tied to the fourth premolar creates a reinforced anchorage unit that is sufficient to tip the maxillary canine tooth without suffering any displacement. A loop of 24 or 26 gauge wire is then tightened around the coronal third of the mesioversed canine tooth. The twisted end is then cut 10 to 14 mm long and bent to form a hook. The hook is aligned in the direction of the anchorage. An orthodontic bonding agent or a flowable composite resin is applied around the loop and cured to bond the hook to the tip of the canine tooth. A coronal extension with composite has been previously reported as an alternative to wires and buttons placed on the canine tooth.\(^5\) Finally, an elastic chain is cut at 80 to 75% of its resting length and stretched from the hook to the mesial two prongs of the bracket. The elastic is changed every two weeks until the desired position of the target tooth is reached.

During the move the operator may discover that the maxillary canine tooth slides on the lingual surface of the mandibular canine tooth and tips it buccal in its effort to create enough space to slide by distally. One is left with a normally positioned maxillary canine tooth but a buccally tipped mandibular canine tooth. Once the maxillary canine tooth is distal to the mandibular canine tooth, the mandibular canine tooth will relapse slightly but, unfortunately, may not relapse all the way to its original position. At that time, a second brace needs to be designed to move the mandibular canine tooth back to its original position. The contralateral mandibular premolars 05, 06, 07, and sometimes 08, are cleaned and etched as previously described. A figure 8 wire or a lingually oriented Stout loop wire is now placed around the premolars with its twisted end on the lingual surface of premolar 05. Flowable composite is used to cover the wire between the premolars, taking care not to create interference with the occlusion. The twisted end is cut 10 to 14 mm long and bent into a hook using bird beak pliers. Next a 24 or 26 gauge wire is looped around the coronal third of the displaced mandibular canine, and twisted tight. The end is cut appropriately and bent to form a hook. The hook is aligned with the hook of the contralateral premolars. An elastic chain is cut at 80 to 75% of its resting length and stretched from one hook to the other. The elastic is changed every two weeks until the desired position is reached. The hooks have to be designed in such a way that the elastic chain remains close to the floor of the mouth, under and out of the way of the tongue. If it is in the way of the tongue, it irritates the patient who then tries (and succeeds) to dislodge the appliance with its paws. Even if one is careful, it is necessary for some patients to wear an Elizabethan collar during the orthodontic movements. While the second movement is taking place the elastic chain on the maxillary canine tooth is replaced by a twisted wire, extending from the hook to the bracket, and serving as a retainer to prevent relapse.

Once the second move is completed, the appliances are removed and the teeth are cleaned and polished with a fine, fluoridated pumice. Follow-up radiographs are recommended to verify that the radicular systems of the affected teeth were not damaged.
Discussion

The first choice when presented with this condition is whether to opt for surgical extraction or orthodontic move. Surgical extraction can be performed by most general practitioners and thus is easily available. On the down side, it is a surgery with bone and tooth removal and there is definite possibility to create an oronasal fistula. The orthodontic correction is more involved and more expensive but it yields a much better result for the patient; all its teeth are present and in the correct position. The orthodontic movement should be chosen to provide an infectious and pain free oral cavity for the patient. Not to mislead, defraud, or allow owners to propagate questionable genetic traits in the animal. A signed orthodontic release is recommended.

The first orthodontic movement; distal move of the maxillary canine tooth, has been described before. Variations exist but we prefer this specific technique because it affords three advantages. 1) The molar and fourth premolar are wired together, making it a strong reinforced anchorage. Techniques where the elastic chain is stretched between the fourth premolar and the molar, may result in movement (tipping and/or translation) of the fourth premolar and/or molar. 2) Because the chain stops at the mesial end of the bracket, it is relatively simple to change it with the animal awake and rare is the instance where one has to sedate a patient to change the chain. When the chain is stretched to the first molar, changing it becomes more problematic. 3) The hook around the canine tooth is in the line of the pull, no rotational forces are at work. On the other hand, when you place a lingual button on the buccal surface of the maxillary canine tooth and you pull distally, you subject the tooth to unwanted rotational forces. A lingual button is also a lot easier to dislodge than a looped wire. The previously reported technique by forming a snowman extension of the coronal tip has been utilized by one of the authors. This technique does allow easy replacement of the masel chain on the canine tooth. However, removal of the flowable composite at the completion of the orthodontic movement increases chance of damage to the tooth. Finishing burs, which generate heat, are required to remove large portions of the composite material and the coronal tip of the canine tooth may be damaged without careful removal.

As for the second move, the principles remain the same: 1) Place the anchor hook in line with the position you want the mandibular canine tooth to return to. 2) Make certain the anchorage unit is stronger than the tooth root to be moved. The anchorage unit value is often equated to the function of the root surface area. However, in reality, the actual value is nearly impossible to mathematically calculate. Differences in tooth size, shape, number of roots, age, placement of anchors on the crown, and other physiological variables can factor into root surface area. Clinical judgment accounting for the number, size, shape and length of roots is necessary to select anchorage units. 3) Design a comfortable appliance otherwise the patient gets irritated and destroys it. 4) Prevent relapse of the maxillary canine tooth.

The mandibular canine should move in a diagonal direction toward the first or second contralateral premolar, thus the hook should be placed in that region. A strong anchorage unit is always desirable; so wire and bond at least three premolars together. This way the anchorage unit does not move, and only the target canine tooth does. The elastic chain should stay well under the tongue so the patient is not irritated by it. Therefore, make sure the hooks are bent low over the oral mucosa. Finally, make sure the maxillary canine is not going to relapse in the way of the mandibular canine tooth. This is easily accomplished by replacing...
the masel chain by a fine twisted wire that puts no further force on the maxillary canine tooth yet maintains the tooth in its new position.

Once the teeth are all in correct position, the braces can be removed. The mandibular canine tooth now serves as a retainer for the maxillary canine tooth and the pressure of the lower lip is usually sufficient to prevent relapse of the mandibular canine tooth.

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Prevalence Of Oral Diseases In Oncilla (Leopardus Tigrinus) In Captivity
Brazil.

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Brazil represents the country where exists the largest diversity of fauna and flora of the planet. Examination of the oral cavity for early detection and correction of problems should be a part of the general health care program in any institution that deals with wild animals. Dentistry in exotic carnivores is becoming more common as their level of care is enhanced. Variations in crowns, roots, endodontic systems, and numbers of teeth have been reported for virtually all known species. Developmental, congenital, and hereditary factors may be involved with dental abnormalities. Among these are environment, nutrition, dietary textures, stress, inflammations, injuries, and infection; many of these factors are possible causes of the variance between the captive and wild groups. These cases present many interesting challenges, but adaptation of currently accepted dental procedures, use of newly developed instrumentation, and educated improvisation can take care of almost any situation that a practitioner might encounter. It must be kept in mind, however, that there are virtually no medications, medicaments, or drugs that are approved for treatment of the various exotic carnivores. Therefore, the treatments that are discussed in this article should all be considered as off label use, and be reviewed closely before being applied to patients. Zoo veterinarians should adopt and follow a strict routine of physical examination of the oral cavity whenever any animal is chemically immobilized. Furthermore, handlers should be trained to recognize early signs suggestive of oral diseases.

A complete oral examination and dental work-up normally require the use of general anesthesia to allow proper and safe access to the oral cavity. Signs that are suggestive of oral disease vary greatly, but may include a decrease in appetite, external facial swelling, draining tracts, bleeding from the mouth, excessive salivation, nasal discharge, increased or reduced activity, aggression, and indications of pain or discomfort. Early in oral disease, subtle signs of the problem may be exhibited, such as modification in eating or chewing pattern, alterations from normal behavior activity, a gradual weight loss, and periodic upper respiratory type infections.

Periodontal disease is frequently considered less common in wild exotic carnivores compared with their captive cousins. Animals in the wild typically have much shorter life expectancies than those in captivity, however. In most cases, when this theory is expounded, diet and environment are often indicted as potential causes periodontal disease. These two alleged offenders cover virtually everything, but even with this all-encompassing charge, defendable researched has yet to reach the point of proving or disproving their guilt. Clinically, signs of
halitosis, anorexia, guarded or hesitant chewing of food, jaw quivering, and excess salivation; in most cases, however, no clinical signs are observed. Gingivitis may be associated with periodontal disease, malnutrition, injury or penetrating foreign bodies, viral infection, neoplasia, kidney disease, teething, or other problems; an appropriate work-up is required for all cases. The typical steps of periodontal treatment is supragingival scaling or cleaning the teeth of calculus and plaque, polishing, and fluoride application, if appropriate.

Exotic carnivores can commonly place great stresses on restorative materials which results in cracks, fractures, or loss of restorative materials; restoration is best avoided when it is not essential. In more advanced cases where pulpal exposure occurs as a result of excessive attrition, endodontic therapy (root canal, pulp capping, and so forth) or extraction is typically required.

The oral cavities of nine oncilla (N=9) were examined. These animals were anesthetized by routine procedures in three different Zoos of Brasil. Among the examined animals, 67% (6) presented dental calculus, 33% (3) presented gingivitis, 11% (1) presented periodontal pocket, 22% (2) presented dental abscence, 56% (5) presented dental fracture, 11% (1) presented gingival retraction, 33% (3) presented pulp exposure, 11% (1) presented dental wear and 11% (17) presented resorptive dental lesion. The present work could evidence the high prevalence of oral lesions in oncillas maintained in captivity in Brazil, where 67% of the animals presented some type of lesion. Among the lesions, those related to the periodontal disease and the dental fractures were more prevalent. The present work could evidence the prevalence of the various types of oral lesions in oncillas (Leopardus tigrinus) in captivity in Brazil, results not published in the literature regarding these species. In conclusion, the current oral condition of these animals is unsatisfactory and indicates that measures must be taken regarding prophylaxis, diagnosis and treatment of the oral lesions, in a way to reduce the negative impact of the local and systemic consequences, originating from the oral problem. Preventing medical problems of the oral cavity preserves the efficiency of the digestive process. This, in turn, contributes to maintenance of health, improves reproductive ability, increases life expectation, and substantially improves the patient quality of life.

References

Oclusion Of Dog Cadavers After Sagital Split Osteotomy To Correct Skeletal Malocclusions

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Introduction
Skeletal malocclusions are alterations in the growth of the mandible and maxilla which cause tooth malpositions and consequently, impairment of the masticatory function. In most cases, some discomfort can be caused due to contact tooth to tooth or tooth to soft tissues (MITCHELL, 2005). Nowadays, in Veterinary Medicine, these traumas have been treated palliatively because there is not any surgical procedure established to be applied in animals so far. In Human Dentistry, the orthognathic surgery has been the most indicated treatment by the professional to correct severe skeletal malocclusions, offering esthetic and function benefits to patients (MIRANDA, 1999; MEDEIROS, 2001).

With growth factor eliminated (in adults), bone correction by means of orthodontic devices become often limited or non-viable (MIRANDA, 1999; MEDEIROS, 2001). Thus, orthognathic surgery appears as a feature that comes to restore along with the orthodontics procedures the dentofacial harmony, and currently it is used as orthodontic routine protocols in humans (ARAÃO; ARAÃO; ARAÃO, 2000). The orthognathic surgery is a restorative procedure, acting in the basal bone, alveolar bone and oral soft tissues (MEDEIROS, 2001); it is also a viable option for patients with any severe dentofacial condition (PROFFIT, 2002).

Currently, there are few papers related to the proposal of restoring the oral functionality and eliminating the pain caused by skeletal malocclusion in dogs. Lohse described, in 1977, a technique for sagittal osteotomy in a dog mandible, aiming at surgeons dentist training, in order to practice and gain experience before performing this kind of surgery in humans. Based on the Lohse description (1977), this study sought to develop and analyze the feasibility of a surgical technique for mandibular bone correction in cadaver dogs, preserving vascular, dental, nervous and soft tissues, based on the human orthognathic surgery principles. This research aimed to evaluate the technical feasibility of intraoral sagittal osteotomy in the mandible and the occlusion obtained at the end of this procedure.
Materials and Method

The first twenty dog cadavers with skeletal malocclusion (type II, III and IV) were selected. Brachycephalic dogs were discarded due to their relative prognathism condition, considered as a breed standard. Other heads with abnormalities such fractures, tumors and malformations in the region of the mandible angle that would impede the sagittal split osteotomy were discarded too, as well as edentulous samples with loss of teeth canines, lateral incisors, fourth premolars and first molars, because these teeth form the main occlusion key in these animals.

The oral mucosa was incised caudal to the fourth premolar tooth, near to the mucogingival junction (approximately 3 cm), extending to the coronoid crest. Then, a flap was folded down, allowing the viewing of the mandible body, mandibular foramen and annexed soft tissue. The outline of the bone was performed later with a 1 mm diameter laminated bur in a low speed handpiece. The outline extended from the mandibular foramen, toward the alveolus distal margin of the third molar tooth, traveling rostrally between the alveolar septa.

The vestibular cortical bone was also deeply lined, parallel to the first molar tooth root in order to remove the entire vestibular cortical layer, avoiding the mandibular canal. Osteotomy from the mandibular foramen to the ventral edge of the mandible, as recommended by Lohse (1977)8, was not performed. Promptly, the osteotomy was deepened with a micro reciprocating saw help. This allowed performing a finer cut, maximizing an osseous surface for subsequent plates and screws placement. The micro-saw was adapted to the dental handpiece, keeping it at low speed. The blade was introduced in a sagittal way in the delineated region; then, the cut was deepened until the dorsal limit of the mandibular canal, preserving the neurovascular bundle. In order to separate the vestibular and lingual cortical plates, a fine chisel (0.5 to 1cm of wideness) was placed into the cut made by the micro-saw, distal to the lower first molar tooth. With the chisel sharp edge projected to the vestibular cortex it was performed light and precise hammer blows. Then, the chisel was repositioned in the retromolar region, parallel between the two cortical plates and therefore, with light hammer blows, both cortical plates were separated by spontaneous fracture from the mandibular foramen, covering the entire mandible ventral margin to the ventral edge of the osteotomy in the vestibular cortex. When the separation of cortical did not happen completely, it was necessary to put the chisel back again between the cortical plates and applied force gradually until their separation. Gentle lateral movements with the hands also helped in the separation of the cortical plates.

After performing bilaterally osteotomy, it was obtained a bezel cut which allowed both the distal and mesial movement of the mandible, with the preservation of the inferior alveolar bundle.

In cases of twisted jaw (æewry mouth”), it was performed a sinfisis disjunction in order to set independently each side of the mandible in a normal occlusion.

In retrognathia cases, rostral mandibular movement was performed, increasing the distance between the incised bone edges, but still keeping some contact between the cortical ends of the bezel, important point for fractures consolidation.

After mandibular occlusion repositioning (occluding the lower canine teeth in the interdental space between the upper canines and lateral incisors) and adequate bone split edges coaptation, the mandible was tied to the upper maxilla with steel wire using the orthodontic buttons previously placed in canines and lateral incisors teeth as anchor points.
The fracture fixation was performed by means of a miniplate and monocortical screws or just with bicortical screws, seeking preferably the three bicortical screws technique, two of them placed dorsally to the mandibular canal and the other placed ventral to the mandibular canal. In this case, it was used 1.5 mm bicortical screws in diameter and of varying lengths (7, 9, 11, 13 and 15 mm), respecting the obtained measurement by a cortex meter. The bone perforations were made with a drill of 1.1 mm in diameter. Intraoral radiographs were performed to access the fixative material position.

**Results / Findings**

The subtraction of the overjet values obtained before and after the mandible sagittal osteotomy showed a wide variation, generated by the movement magnitude during each performed procedure. The Wilcoxon test for the absolute difference between the initial and final overjet measures. The test evaluate if the variation is greater than zero and showed that it was significant (almost 5%). After the mandible repositioning and fixation, the final occlusion showed different and new premature contacts (figure 1, 2 and 3) that could be reduced after wearing the involved teeth, resulting in equilibrate chewing force distribution.

**Discussion**

At the end of the surgical procedure, the most critical point was the assessment of the final occlusion. In all cases, there was premature contact in the region of the lower first molar with the upper fourth premolar and upper first molar teeth. It was observed contacts in the anterior (rostral) region too, between the upper and lower incisors and canines teeth. In some cadavers, there was more evident contact on one side of the mandible or in a specific teeth. In these cases, it was suggested to wear the cusps in greater contact, seeking harmony between the chewing forces distribution. This interference, as well as malposition of teeth turned it difficult to repositioning the mandible in normal occlusion. Interferences could be assessed in advance with the handling of study models, as suggested by Sickels, Jeter and Aragon, in 1992. It was observed that the planning and surgical-orthodontic treatment is crucial to the ultimate orthognathic surgery success on live animals. Cadavers that had no dental malocclusion associated with skeletal malformations were the only which showed favorable immediate outcome after the procedure.

**Conclusions**

In conclusion, the intra-oral mandible sagittal osteotomy in dog is viable. However, it is important to accomplish a previous orthodontic-surgical treatment planning in order to be performed to acquire a satisfactory occlusal arrangement during the surgery in vivo.

**References**

Poster session
Dentigerous cyst extraction in a mare

1 – Antonia Maria do Rocio Binder do Prado
2 – Cassiana M. G. Ramos
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Introduction

Resulting from an abnormality of the embryonic tissue at close of first gill slit, the dentigerous cyst is identified in young horses along the petrous portion of temporal bone and paranasal sinus, containing elements Dental singly or combined (dentin, cementum and enamel). The odontogenic cyst is defined as a cyst that appears in the areas of teething, located in the mandible and maxilla, which is characterized by an epithelium composed of cuboidal or columnar cells, both in surface and crypts in the thickness of the epithelium. The lesion usually in the anterior mandible. The area of equine dentistry is extremely important for horses to be healthy and have an athletic performance that is required of them.

Due to the changes occurring in the horses by human intervention, they suffered great changes in habits and eating patterns through domestication and confinement, requiring ever more reproductive performance. Formerly in the wild horses moved from 12 to 18 hours grazing on natural pastures.
The teeth of the horses have continuous growth, but the wear did not occur as in the past when the dietary of concentrate was less than the forage offer. Decreasing the time of ingestion stimulates the occurrence of more vertical chewing movements, changes predisposing to wear. Dental diseases are relatively common in horses, with an estimated prevalence of 8 to 80%. Odontogenic cysts are lesions that frequently occur in the maxilla and / or mandible. They are formed from epithelial debris associated with odontogenesis. The most frequent types are: periapical cyst (65%), dentigerous cyst (24%) and primary cyst or keratocyst (5 to 8%). Most of these cysts are managed in the dental office, undergoing surgical procedures as simple enucleation, curettage, marsupialization and tooth extraction. The intervention of the cysts in the maxillary sinus can lead to fistula formation oroantral and chronic sinusitis. The mandibular dental abscesses occur in any age and commonly in horses of 3 to 6 years. Usually the third and fourth premolar teeth are more involved (MULLER and Lowder, 1998). The frequency of periodontal disease (PD), by accumulation of dental plaque and calculus, is relatively low in the teeth of horses (Baker and Jack, 1999). The periodontal lesions are characterized by a progressive inflammatory condition of periodontal tissues including gingiva, cementum, alveolar bone support and periodontal ligament (bearded-SELMA et al., 2004). Therefore, it can be concluded that the force of friction as the normal chewing process and creates extremely effective in maintaining oral health of the horses’ teeth healthy (BAKER AND JACK, 1999).

The clinical presentation is usually at two years old, being observed more frequently at the base of the pinna unilaterally. It consists of a volume increase, with the margin of the fistula pina, with the presence of mucous secretion. The diagnosis is based on historical, clinical and radiographic evaluation of the affected area, and fistulography aspirate and cytology. Treatment consists of surgical excision of tissue, its repression is necessary because of its consistency and adherence to the petrous temporal bone (Wilewski & Pence, 2002).

**Case Report**

It describes the disease in a horse, female, Pure Blood English racing, with two years of age, showing a saccular swelling in sub-unilateral right ear, with fistulous tract of mucous secretion which became purulent, located near the mastoid process of petrous portion of temporal bone.

**Material and methods**

After clinical examination revealed a prominence over the surface of the temporal bone (Figure 1). Faced with this assessment were required laboratory tests and X-ray which diagnosed a radiopaque attached to the temporal region of approximately ten centimeters in length (Figure 2). Was performed the surgical procedure to remove the cyst dentígero. During surgical exploration of the locus, there was adherence to the temporal bone cyst. Was performed an excision of fistulous tracts through the fistula opening below the headset until the temporal bone about. The approach was performed through a longitudinal incision following the path of the cystic sac. After resection of the cyst and the curettage of the temporal bone, the remnants of dead cells and inflammatory tissue from the edges of the
cystic sac were removed with the aid of an osteotome. The synthesis of tissues was performed with isolated sutures simple pattern and placement of a drains.

**Discussion**
The occurrence of dentigerous cyst in horses is rare and when occurs is reported in young animals unilaterally, as happened in this story. A cyst is defined as a cavity lined with epithelium, containing or semi-solid, originated of the expense of embryonic epithelial tissue. The epithelium of odontogenic cysts may originate from the following structures:

a) Epithelial remnants of dental crown
b) Epithelial remnants of Malassez (remaining cells of developing tooth roots located within the periodontal ligament)
c) Epithelial debris (remnants of dental lamina)
d) The actual tooth germ, including enamel, dental papilla and dental lamina.

The most accepted hypothesis for the formation of the cysts is associate to the proliferation of epithelial debris, leading to formation of islets, being avascular, degenerate in its central region. Being away from the adjacent connective tissue, they release enzymes that degenerate their own cell protoplasm, liquefying the dead cells. The intracystic fluid has a higher osmotic pressure than the liquid of surrounding tissues, which leads to progressive cyst growth. The dentigerous cyst is originated after the formation of dental crown. An accumulation of fluid between the enamel epithelium and dental crown, directly connected to a tooth root. It is the most aggressive of the odontogenic cysts and may reach high volumes, with bulging of the cortical bone.

Radiographic image is characterized by a well-defined by radiolucent cortical bone. The radiographic image should not be less than 2.5m of extension, to differentiate it from the image of the dental sac. It can be in the central, lateral, or circumferential erupção. The primary cyst arises from degeneration of cells in the stellate reticulum of the organ of enamel, renter start before the formation of mineralized tissue. It would grow to the point where the series would be a normal tooth, or an impacted tooth from a supernumerary tooth. It occurs more frequently in the younger age group at 4 years of life. The region of occurrence is higher in the posterior mandible. Swelling, drainage, pain and infection can occur in 50% cases. The image appears as a radiopaque ring. The periapical cyst, the most commonly found as the result of an inflammatory stimulus from the dental pulp.

In larger cysts may require tooth extraction and its curettage. It’s the approach transmaxillary access to excise the cyst and lower meatotomy for temporary drainage of the maxillary antrum. The oroantral fistula resulting from tooth extraction is fixed with simultaneously curettage autologous bone graft (septal or conchal mastoid cortex). This procedure prevents the occurrence of oroantral fistula and sinus suppuration, ensuring the complete removal of the cyst.
Conclusion

There was a complete healing of surgical wounds (Figure 4). We noticed that the surgery is a viable alternative for the treatment of the odontogenic cyst with extension into the maxillary sinus, may be adopted simultaneously conduct dentistry with the goal of prevention of suppuration and sinus resection of the cyst.

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Use Of The Rigid Fixation On Sagital Split Osteotomy In Dog Cadavers

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Introduction
The orthognathic surgery in dogs has been studied to correct skeletal malocclusions in this specie. An important aspect to be considered after this procedure is the quality of the period after surgery. In human dentistry, de immediately masticatory function is required, and a rigid fixation can prevent abnormal osseous consolidation. This research evaluate the different possibilities of the mandible rigid fixation after sagital split osteotomy in dog cadavers and describe important aspects of these techniques.

Method
Twenty dog cadavers with different sizes and with skeletal malocclusion (type II, III and IV) were selected and submitted to the bilateral intra-oral mandible sagital split osteotomy. After sagital osteotomy and repositioning of the mandible, the bone fractures were fixed with titanium mini-plates and monocortical screws, 3 bicortical screws or with the combination of both technique (1.5mm of diameter â€“ Toride Com. Ind. LTDA), according to the characteristic of bone fracture, animal size, and kind of mandible movement (retraction or advance).

Results
Different shapes of mini-plates could be used at the ventral cortical of the dog mandible and the titanium was considered a good material to work, because it could be moulded, according to the bone shape and fracture. The 1.5mm size of mini-plate and screws could be used in all animals studied, independent of their sizes and weight. The most common bicortical screw size used had 9mm of length in small and medium animal sizes and 11mm length on large animals (Table 1).

Discussion
The rigid fixation, even with limited indications to jaw fracture stabilization, is useful when there are no teeth to use dental splint. On orthognathic surgery, it was an excellent material and offered a very stable fixation, without movement of the bone fractured after manual manipulation. Even so, the high masticatory forces of the dog and their unknowing about post
surgery care suggest that is necessary a intermandibular block to acquire a correct bone consolidation.

Conclusion
The rigid fixation is easy to use, offer a stable fixation and should accelerate the post surgery recuperation, but maybe is necessary add an intermandibular block to acquire a correct bone consolidation, while enough studies about test resistance can not confirm the real stability of this kind of fixation.

References:
Characterization Of Cementum Surface In Teeth Of Cats, By Scanning Electron Microscopy. Preliminary Results.

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Introduction
Cementum is a calcified, avascular mesenchymal tissue that forms the outer, covering of the anatomic root. It is the least known of all the mineralised tissues in the body. Researches about the subject in cats, are very scarce. Using scanning electron microscopy (SEM), root cementum surface appears formed by globules which correspond to the extrinsic fibers (Sharpey fibers). This fibers come from the periodontal ligament and insert into the cementum, covering almost 100% of the cervical root surface, forming the acellular cementum. Intrinsic fibres distributed among projecting extrinsic fiber bundles are formed by cementoblasts that can be seen inserted in the matrix, as cementocytes which processes form the canaliculi seen in the developing lacunae. This structures are seen in cellular cementum, which is found in the apical third of the root and in the interradicular areas. The main purpose of this study was to characterize the cementum surface defining the different patterns of Sharpey fibres distribution and their diameter, in permanent normal teeth of cats.

Materials and method
The study included 27 permanent teeth (6 upper canines -104 and/or 204-, 4 upper third premolars -107 and/or 207-, 4 upper fourth premolars -108 and/or 208-, 3 lower canines -304 and/or 404-, 3 lower third premolars -307 and/or 407-, 4 lower fourth premolars -308 and/or 408-, and 3 lower first molar -309 and/or 409-), obtained from 4 adult cats (all DSH, 3 female, and 1 male, aged between 4 and 8 years old). Incisors, upper second premolars, and upper first molars were not included because of their small size. In total 38 roots were examined, divided in cervical third (35); mid-root (32), and apical third (37). After careful extraction, each tooth (root) was examined, in order to discard those with lesions or defects, only teeth with no radiographic or clinical signs of disease, were used. Teeth were obtained from patients of the Veterinary Teaching Hospital, University of Buenos Aires, from the Dental Service of the same university, and from private practice. Preparation of specimens: Teeth were fixed and stored in formaldehyde (10%) until use (minimum time 48 hours), washed in deionized water, submerged in sodium hipoclorite 5% until no soft tissue could be detected visually (approximately 1 week), then washed in deionized water, dehydrated in ethanol ascendant concentration (25, 50, 75 y 100%) and then air dried. Roots were mounted in order to expose its buccal surface to the SEM, coated with gold-palladium, and were examined using a PhilipsÂ® XL 30 SEM with an accelerating voltage set at 5 kv and high magnification (between 500 and 1500X). Other magnifications were used for especial condition. One digital SEM photomicrograph (n=104) was taken at
each root area of interest (cervical third, mid-root and apical third), at 1500X. The density of extrinsic fibres was determined in one area of 5000 square micrometers (the complete micrograph) selecting at random 30 extrinsic fibres (n= in total 3120 extrinsic fibres). The measurements and analysis of the different structures on the digital images were performed by means of Image Tool® 3.0 (UTHSCSA).

Results
1/. Cementum surface pattern
Three surface patterns were found:
A) (Fig. 1) Lobulated surface with regularly distributed Sharpey fibres. In this surface, the extrinsic fibers were well delimited showing different types: circular, polygonal or asymmetric formations. It is the most common surface and appeared in different teeth and root thirds.
B) (Fig. 2) Smooth surface with depressions. This pattern was evident in two different regions of the same teeth.
C) (Fig. 3) Smooth surface without evidence of extrinsic or intrinsic fibres. This kind of surface was seen in the cervical third of two canines.

2/. Extrinsec fibers density
According to the proportion of the root surface occupied with the Sharpey fibres, cementum was classified in three types:
Type 1: Sharpey fibers occupied 80 to 100% of the surface.
Type 2: Approximately 40 % of the surface occupied by Sharpey fibres, without cell lacunae.
Type 3: Surface with areas showing a great variation in the proportion occupied by extrinsic fibres (15-40%) and presenting some cell lacunae.
Results are listed in Table 1.

Intrinsic fibres among the extrinsic fibres increased in number towards the root apex and sometimes formed extrinsic fiber free patches.

3/. Sharpey fibres diameter
Diameters of the extrinsic (Sharpey) fibres (in micrometers) were measured directly from the micrographs, and were grouped according to teeth.
Results are listed in Table 2

Discussion
The cementum pattern (A) morphology and distribution of extrinsic fibres revealed similar results to the others described in the literature. Sharpey fiber diameters in the cat differ from those found in humans (4 micrometers in cats vs. 6 in humans). The cementum pattern (B) presenting smooth surface with depressions, could be considered to be the Sharpey fibres insertions, washed away with the sodium hipoclorite. This pattern, evident in two different regions of the same teeth, could indicate that the cementum of a large part of the root was in remodeling activity (no minerlized tissue). The cementum pattern (C) without fibers, found in cervical region of some feline teeth, could correspond to afibrillar cementum found in humans.
formed following the loss of reduced enamel epithelium. Further studies in cats, including different methods of histological preparation, would be necessary.

**Conclusions**

- Our results suggest a decrease in the density of the Sharpey fibers from cervical toward apical region.
- Sharpey fiber diameter is smaller in the cat than in the humans.
- Further studies should be performed in more cats to establish the characteristics of cementum, including animals suffering from oral disease. Such studies are in progress, by the authors, at the moment.

**References**

Commissuroplasty In A Bernese Mountain Dog

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Introduction
Dogs with congenital excessive and everted lower lips have problems in keeping saliva and water in the lateral vestibules before swallowing. The result of this can be severe drooling soaking the coat on the cranial part of the thorax and consequent dermatitis. A bilateral commissuroplasty can relieve this problem.

Case Presentation
A one year old male Bernese Mountain Dog was referred to our hospital in march 2009 with a severe drooling problem. The owners' major complaint was that the chest of the dog was constantly wet and the skin at this location was irritated and inflamed. The dog was otherwise healthy and happy and had no difficulties in eating or drinking.

It was decided to perform a bilateral commissuroplasty in order to shorten the aperture of the mouth thereby making it easier for the dog to keep saliva and water in the vestibules before swallowing.

After having manipulated the labiae to see if the dog still could open his mouth sufficiently, it was decided to place the new commissurae at the level of the P1™s of the maxilla. Approximately two-thirds of the length from the commissurae to the philtrum needed to be resected and sutured.

An incision was made with a scalpel through the dermis at the labial-cutaneous junction from the level of the maxillary P1 going caudally around the commissura and then again cranially in the lower lip to the level of the mandibular Pl/P2. A similar incision was made on the muco-cutaneous junction and the strip of labia edge was cut off with a pair of Mayo-scissors. Hemorrhage was handled using electrocautery.

In order to preserve symmetry while suturing and to handle the excessive amount of tissue Babcock forceps were placed to hold the edges together in correct position.

Two layers of simple interrupted sutures were placed: The first layer was placed in the mucosa with knots being buried on the subcutaneous side. Beginning at the new commissura and dividing the incision in half all the time keeping control of symmetry. The second layer was placed in the cutis. Monocryl 4.0 with a spatula needle was used for the mucosal side and Ethilon 3.0 with a reverse cutting needle was used for the cutaneous side. The most caudal one centimetre of the incision was left open for drainage.

The dog was turned on the other side and the procedure was repeated.
Postoperatively the dog was given carprofen and buprenorphine as needed. The dog was fitted with a regular nylon muzzle padded with thin sanitary towels. These towels had tape on the back making the towels stay in place and provided the dog with a soft layer towards the pricking suture ends. These towels were very easy for the owner to change several times a day thereby keeping the dog clean and dry. For cleaning chlorhexidine was used. For the first 14 days the dog was only allowed to drink and eat while the muzzle was off and the dog under close observation.

A few sutures ruptured on the left side rostrally (at the new commissura) leaving this side of the opening a few centimetres longer but otherwise healing was uneventful. The cutaneous sutures were removed 14 days postoperatively.

A year later the dog was rechecked and the drooling problem with a wet chest was resolved. The dog can eat, drink and play without any problems and the owners are pleased.

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Dental Pathology In Beef Cattle: An Abattoir Survey.

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Introduction
In recent years, research in large animal dentistry has mainly focused on equine dental pathology related to their status as pet and athlete at the same time. Tooth problems can have a potential important influence on food assimilation and subsequent development, growth or production of the animal involved. Yet very little is known about the impact of dental pathology on the welfare and economics in cattle species. Increased milk yields have been reported following dental rasping in milk cows (Broeze J., personal communication 2004). Mapping the diversity and frequency of encountered dental pathologies provides a basis for further studies. Ingham (2001) recorded dental anomalies in an abattoir survey of 501 cull cows in the north of England. Garlick (1954) reported on dental pathology encountered in a large population of culled oxes in the USA. This report describes dental defects observed in an abattoir survey of beef cattle in Belgium.

Materials and Method
The freshly severed head of each culled animal was positioned on a table posted next to the slaughter line. Using a bright head light, the different cheek teeth arcades and the incisor rows were carefully examined for any dental anomaly. Encountered pathologies were recorded in writing and drawing on custom-made dental record sheets. Teeth were identified using the modified Triadan system (Wiggs and Lobprise, 1997). Only beef breed animals were examined. As one ear, containing the animal-specific ear mark, remained attached to the head, the exact age and breed of the animals could be readily determined based on the Belgian Sanitel identification system for ruminants.
Descriptive statistics were calculated. Independent samples t-test was used to calculate sex-dependent age differences and occurrence of diastemata. Standard statistical software was used (SPSS Statistics 17.0). Significance level was set at p < 0.05.

Results
A total of 507 heads of beef cattle were examined, 72.2% of them were double-muscled Belgian White-blue animals. Median age of the animals was 25 months (range: 12 â€“ 188 months). Bulls (62.1% of the study population) were significantly younger (median age 24 months; range: 17 â€“ 96 months) than cows (median age 68.5 months; range: 12 â€“ 188 months)(p < 0.001).

**Fractured incisors** were observed in 20.7% of the animals (n=105). Fractures involved substantial parts of the incisor teeth with exposure of the pulp canal in 56.2% of these animals (n=59) which was believed to be due to trauma associated with the slaughtering procedure in
33 animals. In the other animals, fractures were sustained a longer time ago based on the appearance of the remaining crowns. Chip fractures of the sharp labial edges of the incisors were recorded in 46 cases. In a further 11 animals, absence of one or more incisor teeth was found. It could not be determined whether this was the result of earlier trauma or due to congenital anelodontia.

**Increased incisor attrition** was recognised in 91 animals (18%) mostly involving 1 to 4 teeth on one side of the mandible and predominantly found in bulls of the Belgian White-Blue race. This condition was associated with malocclusion of the upper and lower jaw in the incisor area in all cases.

**Dental decay**, identified as black-coloured pit-like lesions on the labial surface of the incisor teeth, was encountered in 52 animals (10.3%) with 49 of them bulls (mean age 25.5 m Â± 9.8). Lesions were evenly distributed on the 01-02-03 incisors but less frequently found on the 04 incisors.

**Malposition of the incisors** was seen in 38 animals (7.5%). Overcrowding of teeth caused the central incisors to overlap in 13 of them. In four others, other incisors showed different degrees of overlapping. Rotated incisors were recorded in 19 animals involving bilateral symmetrical rotations in 8 cattle and unilateral rotation of single elements in 12 animals. The degree of rotation varied between 45 and 90Â° and caused the labial surface of the teeth to face laterally. In one animal, 302 was displaced labially and 404 was displaced lingually in another animal.

The presence of diastemata between incisor teeth, as recorded in 33 animals, was no source of food entrapment nor periodontitis problems because the diastema width was relatively high in all cases (median 5mm; range: 1 â€“ 12mm). The highest frequency was seen unilaterally between the 01-02 incisors (58.7% of diastemata) and between the central incisors (30.4% of diastemata).

**Incisor shedding problems** were seen in 17 animals including delayed shedding of milk teeth (n=7), persistent deciduous dentition (n=7) and unequal eruption (n=3). An extra lateral incisor (05) was seen in a 7.5-year-old cow.

Cheek tooth pathology was less frequently encountered. **Cheek teeth diastemata** were recorded in 73 animals (14.4%). Their age (median 35 months; range: 20 â€“ 188 months) was significantly higher (p < 0.01) compared to the age of the other cattle (median 24 months; range: 12 -168 months). The highest frequency was observed in the lower jaw (60.6% of all recorded cheek tooth diastemata) where 87.9% of the diastemata were located between 07-08-09 teeth. In the maxillary arcades 37.2% of diastemata were located between 08-09 cheek teeth and 27.9% between 06-07 cheek teeth. Involvement of both upper and lower jaw was observed in only 5 animals.

Moderate to severe **periodontal disease** secondary to diastema formation was recorded in 41 of those 73 animals (56.2%) involving 4 of the 5 animals with diastemata in both maxillary
and mandibular arcades. Mandibular arcade diastemata were not more associated with periodontal disease than maxillary oneâ€™s did.

**Abnormal cheek tooth wear** was seen in 11 animals (2.2%). Focal overgrowth of tooth ridges were seen in 4 animals. One bull (age 4 years) had bilateral ridge overgrowth on the occlusal surface of the upper 08 cheek teeth without further pathology. A second 7-year-old bull had bilateral accentuated occlusal ridges on the lower 10-11 cheek teeth. A 10-year-old cow had bilateral excess ridges on the upper 08 cheek teeth opposing diastemata between the mandibular 08 and 09 cheek teeth with secondary periodontal disease. A 4-year-old cow showed ridge overgrowth on the occlusal surface of 208 opposing an uncomplicated diastema. In three animals, step mouth formation was seen characterised by a 10 mm step on 208 in a 5-year cow. A 5-year-old bull was seen with a 4 mm step on 409. Opposing tooth loss was not associated with step formation in these two animals. A last 6-year-old cow showed a step on 208 opposing a missing 308. This animal also had diastemata between several cheek teeth in the 4th quadrant arcade. Cheek teeth arcade malocclusion was the cause for the development of bilateral important focal overgrowths of the caudal part of the last upper cheek teeth in 2 animals. Both animals had multiple diastemata with associated moderate to severe periodontal disease.

**Malpositioned cheek teeth** were recorded in 6 animals involving medial displacement in 4 of them (404, 310, 106 and both 106-206). In two animals rotation of 2 teeth was observed (206-207 and 106-206). A single **fractured cheek tooth** was seen in 3 animals (208, 209, 308). **Dental decay** was encountered on the caudal occlusal surface of 211 in 6-year-old cow and on the caudal occlusal surface of 110 in a 2-year-old bull. Three animals had a **persistent deciduous premolar** (108, 208, 306). A single premolar tooth was missing in another 3 cattle (207, 208, 408). An extra cheek tooth positioned palatal to 207 was encountered in a 4-year-old cow.

**Discussion**

Despite the young age of the majority of animals in this study, relatively high frequencies of tooth anomalies were encountered especially at the level of the incisor teeth. Incisor fractures should be less common in cattle because their alveolar attachment allows some mobility which makes them more resistant to sudden forces (Andrews, 1985). In half of the cases with important incisor fractures, trauma from the slaughtering process sustained from falling to the ground shortly after being stunned accounted for these numbers. Still a considerable number of animals expressed incisor trauma including both important as well as chip fractures which can be attributed to their indiscriminate way of foraging which increases the likelihood of prehending rough objects in the mouth.

The high frequency of increased, mostly unilateral attrition of incisor teeth was attributed to malocclusion of the mandibular incisors with the dental pad. This condition is well-known as a heritable defect in the Belgian White Blue breed. It is the direct effect of muscular hypertrophy of the tongue which disturbs the correct alignment of the mandibular incisor part with the dental pad. Affected animals show this condition at birth and develop asymmetric attrition of the incisors which interferes with proper grazing later in life (Felix, 2006).
Garlick (1954) reported an incidence of 19% of dental decay in a slaughterhouse study on adult ox. The lower frequency recorded in the present study was predominant in very young bulls. This finding might be associated with the practice of feeding corn silage which, due to the addition of preservatives has a very low pH. Administering this food to horses also accounts for higher frequencies of peripheral cemental caries in cheek teeth (Vlaminck, personal observation).

The relatively low frequency of cheek tooth abnormalities seen in the present study can be partly explained by the limited proportion of older animals. Cheek tooth pathology such as periodontitis and wear abnormalities are generally considered chronic diseases which take considerable time to develop and to cause expression of clinical symptoms. Ingham (2001) in a slaughterhouse survey of cows reported on very few animals with periodontitis around incisors or cheek teeth. No periodontal disease problems surrounding incisor teeth were encountered in the present study. This condition is more commonly seen in sheep where it is called “broken mouth” and represents important economic losses in certain countries due to premature loss of incisor teeth and development of severe food prehension problems (Laws et al., 1988). Unlike a higher recorded prevalence in mandibular arcades in horses, an equal distribution of periodontal disease around cheek teeth was seen in both maxillary and mandibular arcades in the present study.

Conclusions

Dental pathology is relatively common in beef cattle which warrants further studies investigating the impact of tooth problems on the general welfare of the animals and the usefulness of incorporating dental health management in daily farm practice.

References

Squamous cell carcinoma in European cat (*Felis silvestris f. catus*) – case study

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Squamous cell carcinoma (SCC) is a particularly aggressive and fast developing tumour that infiltrates in surrounding tissues causing significant injuries to anatomical structures. In the macroscopic image the lesion forms irregular hyperplasia. SCC occurs mostly in older individuals of 10-12 years old. No sex or breed predilection was determined. SCC can attack oral mucosa (of gingivae, tongue, cheeks, mouth) and bone structures (jaws). The case study is a clinical description of a squamous cell carcinoma lesion of the tongue diagnosed in a 13-year-old European cat.

A European short-hair cat, female, 13 years old, 3.9 kg bodyweight. In the interview it was revealed that two weeks passed from the moment the first symptoms appeared to the visit at a veterinarian. In this period excessive salivation was observed as well as loss of appetite, incapability to drink water and eat food. In the course of the previous month two incidents of vomiting occurred. The owner ignored these incidents interpreting them as a result of overfeeding the animal. The clinical study revealed: the body temperature of 38.9°C, pink oral mucosa, capillary refill time of 1.5 seconds, symmetrically enlarged jaw and cervical superficial lymph nodes. After conscious examination of the patient's oral cavity, 2 level gingivitis and 3 level plaque were observed in the premolar and molar area of the upper and lower arches. Focal inflammations of the oral mucosa were observed in the area of the oral vestibule and nasal part of the throat. On the dorsal surface of the tongue, along the median sulcus a 10 mm redness was observed. In order to perform a thorough examination of the oral cavity the patient was pre-medicated. Medetomidine solution was used (Cetator 1mg/ml, CP-Pharma Handelsges) in dosage of 0.08ml/ kg. While exploring the oral cavity, a proliferous lesion of 32 x 10 x 15mm was observed on the ventral surface of the tongue. The lesion covered a part of the apex and the tongue body as well as a part of the frenulum (Fig. 1). On the dorsal surface of the apex a pathological area of 14 mm was found that penetrated the ventral surface of the tongue (Fig. 2).
The owner did not agree to further diagnostic examinations nor to a surgery and oncological treatment. Therefore palliative treatment was administered including anti-inflammatory medicines – tolfenamic acid (Tolfedine 4%, Vetoquinol Biowet) in dosage of 0.4 ml/kg and an oily suspension of sodium cephalixin (Ceporex Injection, Schering-Plough Animal Health) in dosage of 0.5ml/kg for the period of 14 days. After some days of treatment, due to deteriorating condition of the patient, it was decided to euthanize the patient. The owner agreed to perform an anatomopathological examination of the corpse. During autopsy some samples for histopathological examinations was taken. The collected segments served to prepare some paraffin-embedded blocks from which histopathological preparations were routinely performed. The preparation was stained using HE method.

The histopathological image of the segments from the apex area revealed numerous wide foci of poorly differentiated squamous cell carcinoma. In the body of the tongue, pleomorphic tumour cells formed clusters of adenous character (Fig. 3). It was observed that some foci infiltrated sublingual glands and nerve fibres (Fig. 4). Moreover, significant damages to muscle fibres were found as well as focus of necrosis and infiltrations of inflammatory cells.

Conclusions:

According to data from literature, in cats SCC comprises 60 - 70% of all proliferous lesions in the oral cavity, whereas malignant tumours of the oral cavity constitute 3% of all tumours. These tumours comprise: squamous cell carcinoma, papilloma, rhabdomyosarcoma, fibrosarcoma, melanoma, granular cell tumor, lymphoma, mastocytoma (2, 3). Oral cavity tumours are usually formed from carcinoma in situ through dysplastic change or they are primarily infiltrating tumours. SCC etiology has not been fully determined. It is supposed that environmental factors and viral infections (Papillomavirus, Feline immunodeficiency virus, Feline leukemia virus, Feline sarkoma virus) contribute to its formation. SCC occurs mostly in older individuals of 10-12 years of age (7). No sex or breed predilection was determined. SCC can attack oral mucosa (of gingivae, tongue, cheeks, mouth) and bone structures (jaws).

Squamous cell carcinoma (SCC) is a particularly aggressive and fast developing tumor that infiltrates in surrounding tissues causing significant injuries to anatomical structures. In the macroscopic image the lesion forms irregular hyperplasia. Ulcerations are also observed. Tumour tissue is fragile and bleeds frequently, which predisposes to repeated bacterial infections. SCC is rarely metastatic. Metastasis in regional lymph glands occurs in less than 25% of cases (7). The therapeutic treatment includes tumour growth control. In cats SCC develops more aggressively. Therefore in case of operative tumours the prognosis is poor. In dogs, in the early stage of tumour development, the treatment of choice is a surgery. Resection of the lesion, keeping a wide safety margin, lead to cure. Lesions located at the back of the oral cavity proper are more invasive, therefore the prognosis is poor. In case of gingival SCC in cats, the percentage of survival amounts to 10-20% and in dogs 84% (1, 3).
Squamous cell carcinoma of lips or cheeks ulcerates more frequently, and is rarely proliferous. Therefore these lesions are often confused with oral mucosa ulcerations. SCC of the lip is less malignant than tongue tumour but is more painful.

In case of SCC of the tongue, when the lesion is visible in clinical study, it usually attacks all layers of the tongue.

Squamous cell carcinoma is radiosensitive. Radiotherapy is used in advanced tumours and in cases of inoperative tumours (3). In case of tongue tumours radiotherapy does not bring the desired effect due to intense radioactive damages to tissues. The suggested treatment of choice includes non-steroidal anti-inflammatory medicines in the form of piroxicam preparation administered in dosage of 0.3 mg/kg once per day (Feldene 0.02g/ml, Pfizer) or combined with misoprostol preparation 3µg/kg once per day (Cytotec 0.2 mg, Pfizer) (5). The medicine mainly inhibits cyclooxygenases: constitutive cyclooxygenase (COX-1) responsible for synthesis of prostaglandins having physiological functions and inductive cyclooxygenase (COX-2) responsible for synthesis of proinflammatory prostaglandins in the inflammatory area. The treatment model is well proven and used by oncologists, however the percentage of patient survival is relatively low.

References:

A Scanning Electron Microscope Study Of Dog Root Cementum Surface

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Introduction

Dental cementum is a calcified avascular tissue that forms the outer covering of the root. On the basis of the absence or presence of cells, it can be classified as cellular and acellular. Cementum derives its organic matrix from two sources: from the inserting Sharpey fibres of the periodontal ligament (extrinsic fibres), and from the cementoblasts, which produce the intrinsic fibres that run parallel to the root surface and approximately at right angles to the extrinsic fibres. Normal cementum does not have a real surface. The limit of mineralization of the acellular cementum or the level of the intrinsic fibers of cellular cementum may be called the surface of the tissue, but this is an arbitrary distinction. Because of the lack of information about the matter in dogs, the aim of this study was to characterize the dental cementum in this species.

Materials and methods

For this study, 37 roots (from 19 incisors, 9 first premolars and 6 second premolars) were removed from dogs aged between 4 and 14 years old, whose weight varied from 15 to 30 kilograms. These animals died of natural causes or underwent euthanasia because of a terminal disease. Each tooth was prepared for Scanning electron microscope (SEM) (Philips XL 30) observation. One digital SEM photomicrograph was taken at each area of interest (coronal and apical thirds of the root), at 1500X. A classification was made in order to group the different surface morphologies found:

Type 1: The insertion sites of the Sharpey fibres are shown as mounds.
Type 2: Smooth surface with microfractures outlining circular or rectangular shapes, considered to be the Sharpey fibres insertions.
Type 3: Irregular surface which seems to have Sharpey fibres projections but without delimitation.
Type 4: Insertion sites of the Sharpey fibres are shown by depressions on a smooth surface.
Type 5: Insertion sites of the Sharpey fibres are shown by depressions on a microcalcospheric pattern (the surface between and in the bottom of the Sharpey fibres depressions shows prominent nodules).
Type 6: Insertion sites of the Sharpey fibres are shown by separate slender fibres, forming the Sharpey fibre bundle.
A total of 74 photomicrographs were obtained, and in each photomicrograph the diameter of 20 Sharpey fibres selected at random was measured in a mesio – distal way (n=1480). The percentage of the cementum surface occupied by the Sharpey fibres was determined in one area of 600 square micrometers, selected at random.

The measurements and analysis of the different structures on the digital images were performed by means of Image Tool 3.0 (UTHSCSA). For statistical evaluation the results were analyzed by Statistix 7.0 for Windows. Differences between the data from different cementum regions (coronal and apical thirds of the root) were tested for significance by Student’s t-test (p<0.05).

Results
Sharpey fibres and intrinsic fibres of cementum surface were seen with different levels of mineralization. In the coronal third of the root, where acellular cement is found, the insertion sites of the Sharpey fibre bundles were densely grouped, being almost 100% of the surface occupied by them. In many cases, they appeared as mounds (type 1) (Fig. 1) and in others they were just outlined by microfractures on a smooth surface (type 2). Some surfaces were more irregular, showing fibres projecting from the mineral front but without the distinction of the Sharpey fibre bundles (type 3). The remaining surface was occupied, in some cases, by fibers lying parallel to the radicular surface in a longitudinal or concentrical fashion, surrounding the Sharpey fibres. Developing lacunae were not seen in this third of the root. The diameter of Sharpey fibre bundles was (mean ± standard deviation) 5.22 ± 0.95 µm.

In the apical third of the root, cellular cementum was found, which had more surface variations than de acellular cementum. Developing lacunae were a prominent feature, represented by cavities that showed in their back walls, openings of the canaliculi and a fine pattern of the collagen fibrils of the intrinsic matrix. Sharpey fibres, generally presented in one of two distinct ways: as projections above the general plane of the mineralized front (type 1), or, as depressions in this front (type 4 and 5) (Fig. 2). They also appeared as separate slender fibres, forming the Sharpey fibre bundle (type 6). The proportion of the surface occupied by them was 40 to 50%. The diameter of Sharpey fibre bundles was (mean ± standard deviation) 5.38 ± 1.33 µm.

The projections represent Sharpey fibres which are mineralized to a level beyond that of the intrinsic fibres because of a relative inactivity in the mineralization process (remember cementum is formed during the entire lifetime). The depressions, on the other hand, represent the site of Sharpey fibres which were not mineralized to the same level as the intrinsic fibres so they were washed away with the sodium hipoclorite during the preparation process, indicating a more actively forming cement. Type 6 cementum probably corresponds to this active mineralization process also. The projections and depressions were never intermingled, they occurred in patches of varying size and distribution. This means that the cementum surface of each third of the root was not the same in its whole extention. However, two different types of cement were rarely seen in the same third.

The diameters of Sharpey fibres in the apical region of the root, were significantly larger than those in the coronal region (p=0.0000).
Discussion
Cementum surface has been studied in detail in human teeth using SEM. Boyde use in his paper teeth of different mammals, including dogs. According to him, there are sufficient differences among humans and mammals to merit a separate and detailed description of human cementum, although he doesn’t make any mention of specific characteristics of dog cementum.

Studies of human root cementum surfaces using MEB mention that Sharpey fibres generally present in one of two distinct ways: as projections or depressions in the general plane of mineralization, something that was also observed in our study (surface cementum type 1, 4 and 5). However, in this animal we also found other kinds of surfaces. Another similarity between these species is the different proportion of surface occupied by Sharpey fibres in the coronal and apical third and their larger diameter in the latter, both things also mentioned in DeLaurier’s paper about cats. This would be related with the different kinds of cementum (acellular and cellular) in the coronal and apical third respectively, which is associated with the presence of developing lacunae and Sharpey fibres showed as depressions only in the apical third, indicating actively forming cellular cementum.

Conclusions
Much more investigations are needed in order to achieve a complete knowledge about the matter. The results of this study may be useful for future investigations, not only veterinarian but also human.

References
The Inflammation Disease Of Periodontal Tissues In A Western Gorilla

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Patient:
- Western gorilla, male, Bosso, born on wildlife in 1972, since 1997 in the ZOO Ramet-Gan in Israel, since 1997 in the ZOO ZlĂın, together with female Judita, born in 1964, that was also born on wildlife, also comes from Israel.
- Weight: 151 kg

History:
- Since September 2009: intermittent lethargy, inappetence, and constipations for about 2-3 days with about monthly breaks.
- Repeated coprological and bacteriological exams were performed, all of them with a negative result.
- During October to December 2009, two teeth were found in a pen.
- Medication with high doses of vitamin C
- Since December 2009 to January 2010, a gradual shortage of the intervals to 14 days between the episodes
- Repeated coprological exams for occult bleeding from GIT - 8 samples in total
  - 7 times negative
  - 1 time positive

At the time the animal was in charge of a veterinarian who had been caring of animal on the regular basis. He started with a symptomatic therapy according to current clinical signs. However, the food intake was decreasing, thus we decided to pursue a further diagnostic work-up on the immobilized animal. For this reason, we built up a team consisting of veterinarians who were tasked to perform the planned exams as soon as possible. The age of the animal was considered as a crucial risk factor, due to a fact the individuals above 40 years of age are more commonly in a risk of cardial problems and a technical obstacles in the ownerÂ’s facility did not allow to use an inhalation anesthesia.

Imobilisation:
Midazolam 1.5 mg/kg BW, (Dormicum) per oral.
Medetomidin 0.03mg/kg BW, (Domitor) + Ketamine 3mg/kg BW, (Narkamon)
- By a Distant technique
When the animal was immobilized, we did a basic clinical exam, including blood tests consisting of biochemistry profile, hematology, and a genetic test. These tests were followed by ECG, gastroscopy, and colposcopy. All tests were negative. After that, the stomatological exam was performed. On all premolars and molars there was observed a layer of partially mineralised calculus (+++) and we also observed hypertrophic gingivitis and deep parodontal pockets. The teeth were markedly moveable and loose. Upon these findings we decided to extract all premolars and molars, except the right mandibular P1. The markedly bleeding wounds due to extractions were treated with a completely absorbable cellulose (Hyprosorb). In total we extracted 8 teeth and we also collected the samples from hypertrophic gingiva and extracted teeth for histopathological exam. For the following 7 days after the procedure the gorilla was medicated with antibiotics (Clindamycine 600mg twice a day) and fed with a boiledcrashed vegetable. Two weeks after the procedure the animal started to eat a normal daily ration.

Histopathology results:
Gingiva : chronic hypertrophic gingivitis
Tooth : purulent periodontitis, purulent pulpitis

References


Rubber Jaw (Secondary Renal Hyperparathyroidism In A Dog)

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The case of a crossbred bitch with chronic renal failure complicated by a clinically apparent secondary renal hyperparathyroidism is described. A demineralisation of a skull was the most important finding.

Eleven-year-old crossbred bitch was presented to the Dogs and Cat Clinic, University of Veterinary and Pharmaceutical Sciences Brno, due to a lethargy and inappetence that have lasted for several days. The bitch had already been examined two years ago and a mild azotemia (creatinine 219.9 µmol/l, urea 18.8 mmol/l) and not well depicted kidneys on a radiograph were found. After that, the bitch was in charge of a local veterinarian. When the bitch was presented to our veterinary hospital, our examination was primarily focused on stomatological problems, as we suspected the complications related to a parodontitis and a possible jaw facture.

The main findings on clinical examination were odontolithiasis, slightly prolonged CRT, small-sized erosions on the oral mucous membranes, mild systolic heart murmur and jaw pain on palpation. On a detailed oral exam we found a teeth mobility without any signs of parodontal inflammation. Extrinsic changes of a parodontal tissue were limited to a marginal gingivitis with a mild reduction of a gingival margin. Maxillary and mandibular teeth were mobile and just a slight power was necessary to deflect the teeth. When deflected, they moved back spontaneously. Mandible was abnormally moveable and it was possible to deflect it significantly on a horizontal plane to the right and left. The bitch was examined by radiology. For this reason, the general anesthesia was induced. Medetomidin was given with a dose of 20 g/kg BW together with a butorfanol with a dose of 0.2 mg/kg BW. When those drugs had taken effect, propofol was aplicated in a single dose of 1 mg/kg BW. During the anesthesia we gave a saline intravenously in a total dose of 300 cc. There was an apparent and significant demineralisation of the jaws on a radiograph. The radiological findings ruled out a parodontal inflammation and related complications as a cause of the problems. The pacient was sent for a futher diagnostic work-up. Hematology and biochemistry examination was performed (Table 1,2). According to the history and results of blood profile the diagnosis of chronic renal failure complicated by secondary renal hyperparathyroidism was made. Demineralisation of the skull was the main clinical result. Rubber jaw is well described in veterinary literature, but the clinical signs of secondary renal hyperparathyroidism are rare. Depending on a severity of the disease, the secondary renal hyperparathyroidism is usually apparent on the radiograph of a skull as a generalized demineralisation. The first changes are usually observed in the splanchnocranial region. The loss of the lamina dura from the regions adjacent to the teeth roots (radioopaque line), and - in advanced stages - reduction or even loss of the bone tissue, and attenuation or even loss of the cortical bone can be observed. The similar changes can
also be observed in some cases in the neurocranial bones. The turbinate bones are well visible due to a fibrous dysplasia and a nasal turbinate bone demineralisation. Fibrous dysplasia in the maxillary region may cause a thickening of the maxilla which moves the teeth out of their normal position. While in the case of secondary renal hyperparathyroidism an osteopenia is the most prominent on a skull, nutritional secondary hyperparathyroidism causes an osteopenia usually localized on spine and appendicular skeleton.

Table 1

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References

Intravital Determination Of Animal Age Based On Tooth Radiographs With Use Of The European Otter (Lutra Lutra) As A Model Organism

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It has been a generally well-known fact that the teeth of heterodont dentition with a finished growth undergo the secondary changes during the animal’s life. The changes can be detected by widely available investigative methods and can be used as a tool for the age determination. Based on the appositional growth, the layers of a dental cement produced by cementocytes grow on the external surface of a tooth root. These layers can be histologically detected and based on their number (analogous to the year rings of the wood) the age of the animal can be determined. The method can only be used postmortally, or with the extracted tooth. The odontoblasts producing a so-called secondary dentine during the life of the animal are present on the internal surface of the root, in a pulp cavity of tooth. The dentine subsequently makes a tooth wall, which consists of primary dentine after the eruption, thicker. If the tooth is vital, this process lasts through animal’s life. The age of the individual can be estimated based on the tooth width (pulp cavity). This effect has been used in a clinical practice in dogs for a long time. The age of the animal can be estimated based on the radiograph of the tooth (canine). This method may be used intravitaly, but one must be aware of the dentine/pulp cavity rate in the tested species and related age.

European otter (Lutra lutra) was chosen as a model animal. The reason for this was that the Department of pathological morphology VFU Brno had led a project of the age determination in died European otters, based on a counting of the dental cemental layers on histopathological images. This project has been planned to be performed from 1st December, 2009 to 30th April, 2010. The canine 104 was used as a model tooth. The total number of teeth examined was 100.

The teeth were collected from the died animals of unknown age. These teeth were radiologically examined prior to their submission to a histopathology. For this purpose we used the dental X-ray machines by Kodak and RVG Kodak 5000. Digital images were made so that they could be further processed electronically. The processing enabled making an exact measurement the dentine wall/pulp cavity width rate. This function is wildly available and used in RVG X-ray machines. Each tooth was measured in the tooth neck region three times, each of the measurements was performed by a different undependent examinators. The tooth neck region was chosen because of the easiness to identify it, so that the measurement may be each time performed at the same place. The result was counted as an average value.

Upon knowledge of the dentine/pulp cavity rate, expressed as percentage and compared with a known age of the individual that had been determined on histopathology, was possible to determine which dentine/pulp cavity rate value corresponds to a particular age of the examined animal. The method may be used in any animal species with the described type of
dentition. Upon the method, the age of the animal may be determined intravitally based on radiograph.

References

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