20th European Congress of Veterinary Dentistry
September 1-3, 2011, Chalkidiki, Greece

The ECVD local organising committee (Basilis Psychogios, Serafim Papadimitriou, Theodoros Petanides), the EVDS Board, the EVDC Board and all the participants would like to thank the sponsors of the 20th European Congress of Veterinary Dentistry for their financial support, their help and assistance that helped us to make this meeting a success.

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We thank all the local sponsors of the ECVD Chalkidiki 2011 for their support!

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### EVDC Pre-congress Training Sessions

**Thursday 1st September**

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| 09.00 | ONF repair, etiology, location and several treatments  
Paul Theuns (The Netherlands) and  
Brook A. Niemiec (USA) | Common Dental and Periodontal Pathology in Dogs and Cats  
Alexander Reiter (USA) |
| 09.25 |                        |                           |
| 09.50 | A Review of the Principles and Practice of the Surgical Treatment of Oral Cancer  
Peter Southerden (UK) | The Importance of Dental Radiographs  
Brook A. Niemiec (USA) |
| 10.15 |                        |                           |
| 10.40 | Coffee Break |                           |
| 11.00 | Oral Surgery | Basic Dentistry |
|       | Chair: Jerzy Gawor | Chair: Cecilia Gorrel |
| 11.10 | Pathologic Mandibular Fractures  
Brook A. Niemiec (USA) | Common Oral and Maxillofacial Pathology in Dogs and Cats  
Alexander Reiter (USA) |
| 11.35 | The Use of Composites and Acrylics for Mandibular Fracture Repair in Dogs and Cats  
Brett Beckman (USA) | Dental Radiograph Interpretation I  
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<p>| 12.00 |                        |                           |
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Cecilia Gorrel (Sweden)

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Halitosis Treatment: Medical and Surgical Management Peter Emily (USA)

Halitosis and Periodontal Disease: a Practice Management Perspective Philippe Baralon (France)
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| 16.00                            | Local and Regional Anesthesia in Oral Surgery  
Alexander Reiter (USA)           | Treatment of a mandibular canine fracture in two bears: two clinical cases  
Thomas Fichtel (Czech Republic)   |
| 16.12                            |                                 | Actinomycosis in a chinchilla  
Vladimir Jekl (Czech Republic)    |
| 16.25                            | The use of neurolept anesthesia and MLK for greater safety for dental patients  
Paul Theuns (The Netherlands)     | Effect of improper dietary mineral content on incisor microstructure of degus  
Vladimir Jekl (Czech Republic)    |
| 16.50                            | Close of congress               |                            |

**Chair: Ines Ott**

**Chair: Theodoros Petanides**
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Oronasal fistula repair

Paul Theuns DVM, Brook A Niemiec DVM Dip AVDC Fellow AVD

INTRODUCTION

Oro nasal fistulas (ONF) usually result in chronic rhinitis. They can be congenital or acquired. ONF requires surgical treatment in most cases. The numerous techniques that have been published are indicators that ONF surgery is very technique sensitive and that the outcome is not always successful.

DIAGNOSIS

Small-breed dogs are often affected secondary to periodontal disease. They often have a history of chronic sneezing, snuffling, and nasal discharge. The fistula can be confirmed when blood or irrigating fluid is seen at the ipsilateral external nares after probing or flushing an alveolus. Radiographs are unreliable in ONF diagnosis because of summation of the teeth, sinuses and labial trabecular bone on vertical pockets.

ETIOLOGY

Oronasal communication can be congenital or acquired. Congenital causes include primary and secondary cleft palate. Primary cleft defects involve the incisive bone and are generally visible externally due to the cleft lip. Secondary cleft palate defects can involve the hard palate, soft palate or both. During fetal development they are caused by failure of the palatal plates of the maxillary processes to fuse with the nasal septum. The primary and secondary defects can also occur together. The congenital defects can be hereditary or due to mechanical or toxic factors during the development of the oral structures. The congenital defects occur most frequently in purebred and brachycephalic breeds. The clinical signs in puppies are nasal discharge, nasal regurgitation and failure to thrive. Aspiration pneumonia is a major complication.

Acquired ONF in canines is most commonly seen after loss, avulsion, or exodontia of the maxillary canines, but can be associated with any maxillary tooth. The most common cause of acquired defects between the nasal and the oral cavity is the loss of maxillary bone associated with severe periodontal disease. Other causes include neoplasia; radiation treatment; electrical shock (110V); penetrating wounds; linguoverted maxillary canine(s); and pressure necrosis (as seen with a traumatic malocclusion). The etiology is the same in felines.

MATERIALS AND METHODS

There are four important principles of palatal surgery:
1. Know your anatomy. The palantine artery can cause severe and potentially life-threatening hemorrhage. Do not use full thickness flaps over the palantine fissures.

2. Palates bleed excessively even if you don’t cut the palantine artery. Hemorrhage control is vital (suction is a must!).

3. Tension-free flaps are necessary to help prevent dehiscence.

4. Dehiscence is quite common and multiple surgeries may be necessary even with the very best surgical technique.

**Acquired palatal defects:**

Acquired palatal defects are usually repaired with a single layer flap. A buccal mucosal flap is elevated by incising it with a #15 scalpel blade and using a periosteal elevator to free the tissue. To increase the working length of the flap the periosteum at the base of the flap is incised. After debriding and scarifying the hard palate mucosa, the flap is sutured to the mucosa using 4-0 or 5-0 monofilament resorbable suture material. A transposition flap utilizing the mucoperiosteum can also be used. The hard palate mucoperiosteal tissue is incised with a #15 scalpel and a mucoperiosteal flap is raised with a sharp periosteal elevator.

A two-layer flap may be used, especially when dehiscence has occurred. A two-layer flap has to be harvested from 2 locations. The first layer is always used to close the nasal cavity. The first layer usually consists of full or partial thickness mucoperiosteum palatine tissue. The flap is raised, folded over the defect and then sutured on the lateral edge. Avoid incising the palantine artery and use a partial thickness flap to avoid exposing the palantine fissure (which would likely create a new oronasal fistula). The second layer consists of full-thickness buccal mucosa and enough supporting connective tissue to ensure viability of the blood supply. The buccal flap is made long enough to cover the defect and the donor site for the palate-based flap. It is sutured with single interrupted absorbable sutures that join freshly incised epithelial edges all the way round the edges of the flap.

**Small round defects**

Small round defects can be covered with a rotation flap. The edges of the defect are thoroughly debrided and the palatal tissue is scarified and a full thickness flap is raised laterally to the defect. The flap needs to be bigger than the defect before rotating the flap to fully cover the defect without tension. Care needs to be taken to preserve the palatine artery and a tension-free flap is critical for success.

**Caudal hard palate defects**

Caudal hard palate defects that are wide can be closed with an advancement flap technique. The first step is to elevate the mucoperiosteum caudal to the defect and to
include part of the soft palate so that sufficient tissue can be pulled forward to prevent tension on the suture line. It is sometimes necessary to create lateral releasing incisions to achieve this.

**Congenital palatal defects**

The minimum age recommended for repair is 8 to 12-weeks but it is preferable to perform the surgery at approximately 4 to 6-months of age. A general rule is to only treat animals that show clinical signs.

**Overlapping flap technique:**

An incision is made into the muco-periosteum 2-3 mm from the dental margin, another incision is made on the contralateral side of the defect to create a fresh wound margin and get the suture line over bone and not over the defect. With a periosteal elevator the flap is raised. The palatine artery has to be meticulously dissected to release it from the surrounding fibrous tissue but preserve it within the flap. The flap needs this blood supply to remain vital. The flap is rotated and placed in a vest-over-pants pattern. The sutures are preplaced in a horizontal mattress pattern and then tightened.

**Bipedical lateral sliding flap** (Pavletic 2009)

Incisions are made along the medial margin of the palate on each side. A small flat periosteal elevator is used to separate the palatal tissue from the underlying bone. Care is taken to avoid injury or division of the major palatine artery. The nasopharyngeal mucosal surface of the soft palate is apposed with simple interrupted sutures. Use a suture material that is absorbed slowly. For closure of the oropharyngeal mucosal surface of the soft palate, use simple interrupted or alternating simple interrupted and vertical mattress sutures. The secondary defects created by the flap advancement will epithelialize within 2 weeks. Dehiscence often occurs with this technique because the sutures are located over the defect.

**Soft palate defects:**

**Split Palatal U-flap** (Beckman Step by Step JVD 2006)

All diseased and necrotic tissue needs to be debrided first. An incision around the defect is made with a #15 or #11 scalpel blade held perpendicular to the hard palate. Rough bone edges should be smoothed with a diamond or carbide type bur. The palatal mucoperiosteum is incised 3 to 4-mm from the maxillary arcade in each quadrant extending to the level of the first or second premolar. Flap incisions begin at the level of the rostral aspect of the defect. The size of the defect, and the patient breed and species must be considered to determine the rostral extent of these incisions. If extending as far as the palatine fisses the flap will need to be partial thickness at the rostral extent. The greater palatine artery needs to be isolated and ligated at the rostral end, while preserving it in the flap and preserving it’s origin from...
the palatine foramen. A periosteal elevator is used to raise the mucoperiosteal flap at the rostral extent of the defect. Stay sutures are placed to aid atraumatic manipulation of the palatal tissue during further elevation. Both sides of the flap are rotated into the defect to cover it and sutured to each other. They are also sutured to the edges of incised palate near the dental arcades if it is possible to do so without tension. The flap may need to be trimmed to accommodate the contour of the defect. Absorbable 3-0 or 4-0 sutures (poliglecaprone, polyglactin, or chromic catgut) are placed in a simple interrupted pattern 2 to 3-mm apart. Digital pressure is used to displace air bubbles and blood clots under the flap to aid accommodation of the flap to the palatal bone surface. The exposed palatal bone will heal by reepithelialization.

**Miscellaneous:**

**Island hard palate Mucoperiosteal Flap** (Woodward 2006)

The first step is epithelial debridement of the defect margins. Next a mucoperiosteal island flap based on the major neurovascular pedicle is developed. An incision is made parallel to the maxillary dental arcade, starting with the 1st molar and extending rostrally to the third incisor. The second opposite incision is made parallel to the midline extending rostrally to the level of the 1st incision. The 2 parallel incisions are then connected at the rostral aspect with a curved incision. All incisions are made approximately 3 mm from adjacent maxillary teeth. A full thickness mucoperiosteal flap is than carefully raised and elevated caudally until the major palatine neurovascular pedicle is identified. Care needs to be taken to preserve the palatine artery whilst moving further caudally until the level of the 2nd molar is reached. Than the island flap is created by making a curved incision to connect the 2 caudal parallel incisions. The island flap has to be rotated 180 degrees to cover the defect. A soft tissue advancement flap is raised to serve as a 1st layer to cover the defect. After the 1st layer is sutured in place, the island flap is rotated and sutured over the 1st layer.

**Auricular cartilage graft technique**

Auricular cartilage grafts (Wetering 2010) can be helpful in providing a scaffolding effect for granulation tissue formation and epithelial migration. In cases where previous surgical repair attempts have failed, this method provides a therapeutic option for fistula surrounded by fibrous scar tissue. Auricular cartilage provides structural integrity and separation of anatomical compartments of the oral and nasal cavity and the cartilage forms a tissue scaffold or platform for granulation tissue migration and subsequent epithelialization over the developed granulation surface. The cartilage graft is harvested after making a longitudinal incision on the inner aspect of the pinna. The size of the graft should be 1.5 times the the dimensions of the defect to allow full coverage. After harvesting the cartilage graft is kept between layers of saline soaked gauze sponges until application in the oral cavity defect. After epithelial debridement of the defect margins, a cruciate-shaped incision is created over the fistula and bone defect. The triangular-shaped flaps are elevated from the bony palate using a periosteal elevator. Care is taken to include the periosteum with each flap. The periosteum is elevated 2-3 mm beyond the base of each flap to further aid in graft stabilization by providing a receptacle “pocket”. The graft is positioned between the mucoperiosteal flaps and the bony palate. The graft is secured under
the mucoperiosteal flaps in a simple interrupted pattern using 5-0 sutures at an interval of 2 mm.

**Conclusion**

ONF can be treated with a variety of different surgeries. The clinician should be comfortable and proficient with several different surgical techniques and choose the most appropriate one for the individual patient in order achieve the best chance of success.

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A Review of the Principles and Practice of the Surgical Treatment of Oral Cancer

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INTRODUCTION

Primary tumours of the oral cavity may arise from the surface epithelium, minor salivary glands or sub mucosal soft tissues as well as from dental structures, bone or neurovascular tissue.

The management of mucosal head and neck cancers is complicated by the involvement of and close proximity to many anatomical structures.

Oral tumours account for 6% of all tumours in dogs with malignant melanoma, squamous cell carcinoma and fibrosarcoma being the commonest. In cats 3% of all tumours are oral tumours with squamous cell carcinoma the commonest followed by fibrosarcoma.

BEHAVIOUR

The behaviour of oral neoplasms depends upon the species in which it occurs, type of tumour, site within the oral cavity and it’s proximity to different structures such as periosteum, extraction sites, periodontal ligament, mandibular canal and nasal cavity.

Various theories of the route of tumour entry to the mandible or maxilla have been suggested but it seems most likely that the tumour enters at the point of contact. In the dentate jaw this tends to be at the junction of the attached and reflected mucosa and in the edentulous mandible this is more likely at the crest of the ridge due to the lowering of the floor of the mouth due to the loss of teeth.

CLINICAL PRESENTATION

Primary malignant oral tumours present with a variety of symptoms including superficial ulceration, tooth mobility (especially several contiguous loose teeth), exophytic lesions, non healing extraction sites and haemorrhage. Advanced lesions may be associated with significant oral pain and difficulty in mastication.

In dogs melanomas are the commonest oral tumours followed by squamous cell carcinoma, fibrosarcoma and osteosarcomas. In cats squamous cell carcinomas are the commonest (70%) followed by fibrosarcomas and osteosarcomas.

EXAMINATION

Initial evaluation should include thorough examination of the oral cavity, inspection and palpation of the tumour, dental examination looking for abnormal position and mobility of teeth and systematic palpation of the accessible lymph nodes (mainly the mandibular lymph nodes) and salivary glands. Irregular enlargement and lack of mobility are highly suggestive of lymph node involvement.

WORKUP AND STAGING

Following a detailed head and neck examination a pre-treatment workup should include a biopsy and radiographic evaluation (or other imaging) of the lesion and chest (+/- abdominal) imaging.
IMAGING

Radiography is important in assessing oral tumour characteristics such as the extent of the tumour and the presence of bone involvement. This would usually involve intraoral dental radiographs and extra oral skull radiographs. Other advanced diagnostic imaging techniques may be used. CT is useful in assessing the intranasal, periorbital and tempo-mandibular joint involvement as well as the extent of bony invasion. Magnetic resonance imaging and ultrasound can be useful for assessing soft tissue infiltration and lymph node involvement.

With the exception of odontomas, the type of tumour cannot be established based on radiographs and biopsy is always required for definitive diagnosis.

Bone lysis only becomes evident radiographically when more than 40% of cortical bone has been demineralized. Radiographs therefore usually underestimate the extent of the tumour. However, the presence of bone lysis is an indication of advanced bone infiltration which influences the therapeutic plan. Good diagnostic imaging is especially important in correctly planning a surgical procedure.

CLINICAL STAGING

Clinical staging uses the TNM system which records the tumour size, local lymph node evaluation and the presence or absence of distant metastasis. Lymphatic metastasis generally follows an orderly and predictable pattern of progression beginning with the sentinel lymph node. Stages are arbitrary divisions which relate to prognosis and treatment.

The TNM-system is based on the assessment of:

- The extent of the primary tumour - T
- The involvement of the regional lymph node – N
- The absence or presence of distant metastases – M

The addition of numbers to these components (e.g., T1, T2, and T3) indicates the extent of the neoplasm or involvement.

PRIMARY TUMOUR

T0 means that no primary tumour has been detected. T1-T2-T3 indicates increasing degree of extent of the primary tumour. Tx means that it is impossible to fully determine the extent of the primary tumour. Tis is reserved for carcinoma in situ (early carcinoma with the absence of invasion of the surrounding tissue). The tumour extent is commonly based on three features: the depth on invasion, surface spread, and size.

REGIONAL LYMPH NODES

The staging value of lymph nodes (N) is assessed by palpation of size, mobility, firmness, single versus multiple nodes, ipsilateral - contralateral, and bilateral distribution. Mobility is a more important consideration than size, because loss of mobility may be an indicator of invasion of the lymph node capsule by the neoplasm, which has been found to be associated with a poor prognosis.
Lymph node metastases is indicators but not governor of survival in cancer as it is possible for metastases to bypass local lymph nodes.

DISTANT METASTASES

Distant metastases is designated by the letter M. M0 indicates absence and M1 indicates presence of distant metastasis.

BIOPSY

The current gold standard for definitive diagnosis is histopathological assessment of a tissue biopsy from the lesion. In order to interpret biopsy results accurately the surgeon should ensure that adequate diagnostic and staging studies were performed. Planning the biopsy site relies on diagnostic imaging. The gold standard of biopsy planning would include CT and possibly on MRI. In the oral and maxillofacial region, CT is preferred due to its ability to demonstrate the extent of bone involvement in finer details. As a rule, an appropriate biopsy should include tissue from the worst part of the lesion. However, the worst part of a lesion may not be readily apparent from its clinical and radiographic appearance; therefore, the collection of multiple biopsies is recommended. The biopsies should always remain within the lesion.

BIOPSY TECHNIQUES

A closed biopsy is obtained by skin or mucosal puncture mostly with a needle. An open biopsy requires an incision and the surgeon can obtain a relatively large amount of tissue for diagnosis helping the pathologist to make a more accurate diagnosis and decreasing the likelihood that the surgeon will make a sampling error though the risk of complications is greater. Open biopsy is the method of choice in oral and maxillofacial biopsies because aspiration of oral tumours usually results in collection of too few cells to provide an accurate diagnosis. Similarly, “impression smears” and scraping the tumour tissue usually do not provide an adequate sample for interpretation. Immunohistochemical studies require the procurement of a large biopsy specimen. An open biopsy may be incisional or excisional. Incisional biopsy is most common and is the procedure of choice for open biopsy of most tumours. Excisional biopsy of a large or deep mass may cause extensive tumour contamination at the time of biopsy and can subsequently limit treatment options.

TREATMENT

The choice of treatment will be governed by the tumour, it’s histology and staging, patient factors such as age and intercurrent disease, the skill and experience of the surgeon and the surgical team. Both surgical resection and radiotherapy are applicable to many oral neoplasms though in veterinary patients surgical resection is usually the treatment of choice.

Benign and well-circumscribed lesions such as cysts and odontomas may be treated conservatively with enucleation or curettage techniques, malignant oral tumours and benign but locally invasive tumours (such as acanthomatous ameloblastoma) require
more aggressive surgical treatment, typically involving removal of a portion of the maxilla or mandible.

Treatment will have either curative or palliative intent – and it is therefore important to establish whether there is a realistic chance of a cure. Primary surgery or radiotherapy can be used for definitive curative treatment of intraoral tumours but only surgery is likely to be curative if bone is involved. Increased tumour depth (associated with an increased chance metastasis) perineural and vascular invasion are poor prognostic indicators as is an infiltrating tumour front as compared to a cohesive pattern.

Treatment planning should include appropriate anaesthesia and analgesia, achievement of adequate surgical margins, the prevention of damage to adjacent teeth amongst other things.

Four types of excision have been described - intracapsular excision which is a “debulking” procedure followed by radiotherapy or for palliative treatment, marginal excision immediately outside the pseudocapsule of the tumour which may be appropriate for a well-differentiated benign tumour such as peripheral odontogenic fibroma, wide excision involving removal of the tumour, its pseudocapsule, and the reactive zone, with complete margins of normal tissue on all aspects (in general, 10 mm of normal tissue is recommended for most malignant tumours) and finally radical excision involving removal of the entire anatomical structure or compartment containing the tumour.

In man (except for primary intra osseous carcinomas and osteosarcomas) it is possible to assess the extent of tumour invasion into the mandible from the surrounding soft tissues and estimate the extent of the resection required. Periosteal stripping is an important factor in the segmental resection of the mandible in malignant disease. Periosteum is stripped from undamaged bone until it becomes adherent or the tumour is seen entering the bone. Once this is established the margin can be decided and bone cuts planned. It is also important to examine the specimen to ensure that bone margins are clear of disease by direct inspection. Periosteal stripping and direct inspection are much less reliable with primary intra osseous carcinomas and osteosarcomas as the cortex and periosteum may look clear as tumour spreads through marrow space and therefore in these cases the surgeon needs to be much more aggressive in the resection.

It may be necessary to excise overlying skin though in most cases is possible to preserve it. Exfoliation of tumour cells into the surgical field may occur during surgery and give rise to local recurrence, or enter the circulation and cause distant metastasis. Therefore the oral tumour should be handled as little as possible, stay sutures may be placed in normal marginal tissue to facilitate manipulation and the tumour may be covered with sterile swabs to protect it. Blood vessels should be tied off as early as possible in the procedure. Once the tumour is excised, a second set of instruments and drapes should be used for the reconstructive stage of the procedure.

SUMMARY

Oral neoplasia is a difficult condition to treat. A thorough knowledge of the techniques of diagnosis, behaviour, staging and surgical resection is necessary for successful treatment.
Pathologic Mandibular Fractures

Brook A Niemiec DVM Dip AVDC Fellow AVD

Pathologic fractures are an increasing problem in our aging canine population. They are challenging to diagnose and treat. This lecture will cover the pathogenesis, diagnosis, and therapy of this disease process.

Oral fractures are a fairly common occurrence in animal patients. They are usually traumatic in nature and can result in significant local as well as widespread damage. With a healthy jaw and good bone quality, a mandibular fracture typically requires a significant amount of force, such as severe fall or a HBC event. These fractures are treated with fairly straightforward fixations and generally respond favorably to conservative (acrylic splint) fixation.

In our aging patients there is an emerging problem known as a pathologic fracture. Pathologic fractures are the result of a weakened area of bone secondary to a disease process. The most common etiology of these weakened areas is periodontal disease, however, fungal osteomyelitis and neoplasia can also degrade the boney integrity.

Periodontal disease is the most commonly diagnosed problem in veterinary medicine. Bacteria and their byproducts cause inflammation, which in combination with the patient’s immune defenses leads to boney destruction. Over time, this chronic periodontal loss loosens the tooth support resulting in exfoliation of the tooth. In the majority of teeth, this occurs before severe bone weakening. In some situations however, the size of the tooth roots in relation to the mandible can cause significant bone weakening prior to tooth exfoliation. This scenario most commonly occurs in small breed dogs, and there are several reasons for this. First, small dogs tend to have more severe periodontal disease than medium to large breed dogs. In addition, small dogs tend to live longer. Finally, and most importantly, small and toy breed dogs have proportionally larger first molars than do larger breeds. Consequently, the root apex of the mandibular first molar (especially the mesial root) lies within millimeters of the ventral cortex of the mandible (figure 1). Another vulnerable area involves the mandibular canines which comprises 60-70% of the strength of the rostral mandible (figure 2). Thus, the mandible weakens to the point of fracture before the tooth exfoliates (i.e. falls out on its own). Pathologic jaw fractures typically happen as a result of just mild trauma, such as jumping off a bed, or a dog fight, or quite commonly during dental extraction procedures. However, dogs can even break their jaw while simply eating.

Although this is typically thought of as a disease of older patients, I have treated a few cases in dogs less than three years of age. Therefore, it is of critical importance that these small patients have regular dental examinations (under anesthesia and ideally including dental radiographs) from an early age. A pathologic fracture should be suspected in any case of a mandibular fracture, especially in the area of the mandibular first molar of small breed dogs. Additional supportive history is lack of obvious trauma, a non or mildly painful patient, periodontal disease elsewhere in the mouth, and lack of response to adequate fixation.
Diagnosing a pathologic fracture is only possible with dental radiographs. In general, skull films are not detailed enough to diagnose periapical disease. The classic radiographic appearance is bone loss around the involved roots and/or a periapical lucency in the area of the fracture. Additionally, a periapical lucency may be seen on another root of a multi-rooted tooth (figure 3).

It is important to realize that a pathologic fracture will not heal (no matter how good the fixation is) if the diseased tooth root is not removed (figure 4). This is because a diseased root acts as a nidus of infection which prevents healing. Extraction of the diseased root is necessary, but unfortunately creates a large defect in the bone which must be bridged. There are several options for dealing with this problem. Ideally, occlusion is maintained and the defect filled with bone grafting material. In this case, healing takes a significant amount of time. The other option used in cases with few to no teeth, is to move the jaw over and allow the occlusion to be slightly off. This is not ideal therapy, but stands a much better chance of healing.

All pathologic jaw fractures are typically difficult to heal due to the lack of remaining bone, the low oxygen tension in the area, and difficulty in rigidly fixating the caudal mandible. These cases always carry a guarded prognosis for recovery. There are numerous options for fixation; however interosseous and circummandibular wires are my treatment of choice (Figure 5). In addition, bone grafting materials such as cancellous bone grafts or Pep-Gen may be indicated.

If a severely diseased mandibular molar is discovered on a routine prophylaxis, extraction will allow for the healing of the bone and avoidance of a later fracture. The extraction must be performed VERY carefully as the normal force used during elevation may be excessive for the weakened mandible (figure 6). This is why iatrogenic fractures of the jaw are relatively common during dental procedures of small dogs. Consequently, dental radiographs are extremely important prior to any extraction, especially in the mandible. It is best to inform the owners of a possibility of a jaw fracture (and/or consider offering referral) prior to attempting extraction of these teeth.

It is important to note, that if one root of the involved tooth is periodontally healthy, there is an even greater chance of fracture due to the increased force needed to extract the healthy root (figure 7). A recommended alternate form of therapy for these cases is to section the tooth, extract the periodontally diseased root and perform a root canal on the periodontally healthy root. This procedure resolves the periodontal and endodontic disease without the risk of jaw fracture (figure 8).

The key to treating pathologic fractures is similar to majority of medicine: prevention. This problem will not occur if the pet has adequate dental care throughout it’s life. Adequate dental care requires exams UNDER ANESTHESIA on at least an annual basis. This is due to the fact that a proper evaluation (periodontal probing) of the distal root of a mandibular first molar is not possible on an awake patient. If properly educated, the vast majority of owners are willing and interested in maintaining oral health. Discussing the severe problems associated with periodontal disease including oronasal fistulas, periodontal abscesses, ocular problems, and pathologic jaw fractures, in addition to the systemic ramifications, will improve compliance.
The Use of Composites and Acrylics for Mandibular Fracture Repair in Dogs and Cats

Brett Beckman, DVM, FAVD, DAVDC, DAAPM

Mandibular fracture repair in dogs and cats has traditionally taken many different forms. Pins, plates, screws and external coaptation devices are all methods previously employed that are relatively invasive. Small dogs and cats and immature animals have very little bone volume to support the more invasive devices often resulting in failure. Noninvasive methods employing composite and acrylic can bypass traditional invasive methods decreasing procedure time and ensuring a comfortable occlusion and rapid return to function.

INTRODUCTION

Mandibular fracture repair in dogs and cats has traditionally taken many different forms. Pins, plates, screws and external coaptation devices are all methods previously employed that are relatively invasive. Small dogs and cats and immature animals have very little bone volume to support the more invasive devices often resulting in failure. Noninvasive methods employing composite and acrylic can bypass traditional invasive methods decreasing procedure time and ensuring a comfortable occlusion and rapid return to function.

PATIENT EVALUATION

Oral fractures are particularly painful. Pain management should be an immediate concern for all patients with oral fractures. Immediate assessment of patient status should take into consideration possible complications of administration of certain analgesics. For example patients with concurrent ocular trauma and potential glaucoma should not be given morphine in that associated vomiting from this agent will result in and acute increase intraocular pressure. Opiates should be avoided or used with caution in patients with respiratory compromise due their potential for causing respiratory depression. NSAIDS should not be used in patients with hypovolemia, dehydration or renal compromise. The patient should be considered as a whole when choosing appropriate analgesics.

A minimum data base should include a thorough physical examination, CBC, chemistry profile, electrolytes, blood gas analysis, urinalysis, thoracic and abdominal radiography and an EKG. Total patient analysis is paramount prior to consideration for sedation and oral evaluation.

Following the evaluation of the minimum database disposition is made concerning safety for general anesthesia and gross and radiographic evaluation of the oral cavity. If the minimum data base suggests that anesthesia is contraindicated preparation is made to compensate the patient for critical issues delaying anesthesia until the appropriate time. If definitive treatment must be delayed a tape muzzle should be placed to minimize additional tissue trauma from movement unless respiratory distress or vomiting are more pressing concerns.

The oral examination under anesthesia should include careful intubation not only for inhalant administration but just as importantly for airway protection. Oral hemorrhage and vomiting are common with head trauma and could severely decompensate the patient if an airway is not immediately established upon induction. A careful thorough
oral examination should include maxillary and mandibular bone palpation, visual examination for swellings and lacerations in and around the oral cavity and skull, open fractures, epistaxis, TMJ fractures and luxations, symphyseal fractures, tooth fractures, tooth luxations and avulsions, malocclusions and lingual trauma. Full mouth dental radiography is indicated following a thorough oral evaluation. Detail obtained from dental radiography allows for detection of lesions not possible with conventional skull films. Oblique and VD TMJ films are indicated if assessment indicates possible problems in this area.

MANDIBULAR FRACTURES

Fractures of the mandible are more common and often more challenging than maxillary fractures in both dogs and cats. Displacement may be significant especially if both mandibles are involved. When repairing mandibular fractures primary attention must be paid to occlusion. If the teeth are returned to proper occlusion with non-invasive techniques, fracture repair is simultaneously accomplished. A proper occlusion eliminates tooth on tooth or tooth on tissue trauma postoperatively that might compromise apposition. Occlusion cannot be assessed without extubation and bite evaluation. Therefore it is often helpful to perform a pharyngostomy to reposition the endotracheal tube so that occlusion can be checked during and after repair.

FAVORABLE FRACTURES

Favorable fractures are mandibular fractures where the normal forces of opening and closing the mouth aid in apposition of the fracture ends. The fracture line in these cases runs from the rostroventral to the caudodorsal mandible. Normal digastricus muscle function pulls the rostral aspect of the mandible caudally when opening the mouth. Similarly the temporalis and masseter muscles act to pull the caudal mandible in a rostral direction when closing the mouth. Therefore the both processes of opening and closing the mouth impose favorable forces to oppose fracture ends in this type of injury. These fractures are often repaired solely with the aid of a composite and acrylic splint applied to the lingual aspect of the teeth as the jaws are brought into occlusion.

NONFAVORABLE FRACTURES

Nonfavorable fractures exist when opening and closing of the mouth provides distraction forces to the fracture ends. When a fracture line runs rostroventral to caudoventral the muscles of mastication instill an effect opposite that of favorable fractures. These fractures require additional stabilization with interdental wiring and acrylic stabilization. Traditional methods aimed at providing minimal invasiveness include interosseous wiring. This is seldom needed when composite and acrylic with or without a tape muzzle are employed during healing. Suturing of soft tissue should be delayed until stabilization is achieved in case interosseous wiring is needed. If this is the case access can be achieved in part via the existing defect.
TEETH AS ANCHORS

Teeth within the fracture line should be salvaged if possible. Severe periodontal disease and/or endodontic disease that is preexisting may warrant extraction in some cases. Treatment of these teeth following fracture healing depends on the ability of the dentist to treat the tooth or the bone loss at the time of the fracture. This topic extends well beyond the scope of this manuscript. Veterinary dental texts provide extensive discussions on periodontal and endodontic therapy for teeth in general. In most cases fracture repair can be completed utilizing the techniques described here. At discharge referral can be scheduled with a veterinary dentist for follow-up care of the teeth involved in the fracture line or otherwise traumatized. It is very important that client communication with this topic is discussed. Pet owners should be notified that traumatized teeth will require follow-up visits with a specialist or qualified individual after discharge from fracture repair. Extraction or endodontic therapy is often indicated especially if the tooth or teeth in question are involved with the fracture line.

ORTHODONTIC DEVICES

Orthodontic massel chain and button configurations have the advantage of providing fixation but eliminating rigidity associated with splints and wires. This may be of special benefit in young patients where jaw growth is not complete to allow some flexibility to further growth. When used alone massel chain and button configurations should be used with tape muzzles and Elizabethan collars to prevent trauma and minimize jaw movement. Orthodontic devices can also be integrated into acrylic splints where additional rigidity is required. Creative application of button and chain configurations may stand alone or form the backbone of acrylic splints providing excellent rigidity eliminating the need for interdental wiring.

INTERDENTAL WIRING

Interdental wiring is a viable non-invasive technique that can be used with or without stabilization with acrylic. It involves placement of 24-26 gauge wire between teeth on either side of the fracture line. Wire is generally placed ventral to the cervical bulge at the mesial and distal aspects of the teeth. Anatomical variations may dictate that the wire be passed through the gingiva to establish purchase. Notching of the tooth with a small round carbide dental bur or the utilization of composite bonding to secure the wire to the tooth are also possible. Wiring techniques are described extensively in veterinary dental texts. The Stout multiple loop technique provides incorporation of two or more teeth on either side of the fracture line. The Ivy loop technique is similar but incorporates only one tooth on either side of the fracture line. For mandibular fractures the loops are tied on the lingual aspect to eliminate problems with occlusion from the maxillary teeth and to act to reinforce purchase of the acrylic. More extensive fractures may require additional techniques. The Risdon’s wiring technique may be used in these instances.
ACRYLICS AND COMPOSITES

Acrylic splints provide a stand alone stabilization technique for many cases of mandibular and maxillary fracture repair. Unfortunately bonding acrylic to teeth is a technique sensitive procedure. At no time can plaque or saliva contact the surface of the prepared tooth or the procedure may fail. Interdental wiring is used in many cases to provide stabilization and ensure incorporation of the splint into something other than the tooth surface. A unique alternative to increase bonding success involves the use of composite acrylic buttons as an anchor. A composite orthodontic button and bracket system is used to accomplish this. A silicone mold on the end of a plastic wand is filled with a flowable composite to accomplish a slight positive meniscus. The mold is placed on a prepared area of the tooth and light cured to achieve bonding. The mold is pulled from the tooth and the button or bracket is left strongly adhered to the tooth surface providing a solid anchor for retention of the acrylic splint. One bracket or button is placed on each tooth to be incorporated in the acrylic.

Manufacture and Placement

The following series of steps are utilized to manufacture a acrylic splint using this technique.

1. Thoroughly clean teeth. If interdental wiring is to be used as an adjunct to acrylic splint stabilization rather than composite buttons the wire should be placed after cleaning.
2. Flour pumice should be used to thoroughly polish teeth and wire to remove plaque. Any plaque will retard the ability of the acrylic to adhere to the tooth. Flouride containing pastes will interfere with material setup.
3. Acid etch all tooth and wire surfaces that will come in contact with the acrylic for 30 seconds. The labial surface of the mandibular teeth and the vestibular (buccal) surface of the maxillary teeth are used to avoid occlusion issues. Thoroughly rinse the etchant and dry with an oil free air source.
4. Place a small amount of primer/bonding agent on the tooth surface where buttons are to be placed following manufacturers directions specifically. Bonding agents vary considerably in details of placement.
5. Place flowable composite into the mold, hold the mold against the tooth, light cure for the recommended time period and pull the mold from the tooth. The author uses an accelerated light cured composite that cures in 5 seconds. As an alternative, fabrication of an anchor can be done without the mold system by adding sequential layers of composite to approximate a similar contour.
6. After the composite buttons have been placed the acrylic splint is applied using a chemical cure self mix acrylic. Cover the proper aspect of the tooth surface for the length of the splint being careful not to involve the gingiva. Ensure a proper occlusion and apposition of fracture ends as the acrylic dries. This is facilitated by preplacement of the endotracheal tube in the esophagostomy site.
7. Rough areas can be smoothed with Goldie g or other burs. Oral hygiene should be encouraged if possible to keep the splint free from food and debris. The device should be inspected at regular intervals to ensure that it is intact. Radiographs are taken at 6 weeks to ensure adequate callous formation. The device is removed and the teeth cleaned and polished.
CONCLUSION

Classic invasive oral fracture repair techniques have led to inadvertent or careless impingement on oral structures including teeth, periodontal ligament, cementum and the mandibular canal and its contents. Young are particularly terrible candidates for plates, pins, screws and osseous wiring due to the lack of mandibular bone while teeth are maturing. Cats and small dogs also lack significant bone volume. Avoidance of these invasive techniques should be considered paramount in dogs and cats of all ages. Noninvasive techniques utilizing composite and acrylic are available to provide excellent stabilization, maximizing patient comfort and minimizing complications. They should be considered as a noninvasive choice in select mandibular fractures in dogs and cats.

Products


References

New Developments of Cone Beam Computed Tomography and its Potential for Veterinary Dentistry

Bert Van Thielen, Olivier Jacqmot Msc, Francis Siguenza, Bassam Hassan Phd

Introduction

A new CT technology, Cone Beam Computed Tomography (CBCT), has recently been introduced in human dentistry [2], [4], [5] and [6]. CBCT technology was quickly adapted in the human clinic since it offered decisive advantages over Multi Detector Computed Tomography (MDCT) in terms of reduced radiation dose, costs and labour constraints.

Radiographic imaging of teeth and jaws of dogs and cats plays an important role in clinical diagnosis for many dental pathological conditions. However, the amount of radiographic information visible on conventional two-dimensional (2D) projection radiographs is often limited due to superpositioning of anatomical structures. Three-dimensional (3D) imaging with 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. At the other side, even in human medicine, dental specific reconstructions options are very limited and even when they are available, it means a complementary financial investment.

For all these reasons, CBCT is taught to be of interest in veterinary dentistry and is therefore been evaluated recently for its use in veterinary dentistry [7, 8, 9, 10]. Concerning the image quality of dogs’ a moderate satisfactory image quality was obtained and concerning the image quality of cats’ a unsatisfactory image quality was obtained [7, 8, 10]. Beside this it was suggested that CBCT could be of potential use in the planning of surgery of mandibular and maxillar fractures [9]. A considerable potential of CBCT for its use in veterinary dentistry was shown previously using a CBCT device for supine patient positioning. However technical and informatical adaptations seems to be necessary for its use in veterinary dentistry, such as removing of the automatic dose reduction system [7, 8, 9, 10]. At the other side the CBCT – unit that was evaluated was one based on the Coupled Charged Device (CCD) – technology, which have generally less performance than these with Flat Panel Detector (FPD) – technology.

In human medicine, a new generation of CBCT is in validation in different universities. This generation is based on the same CBCT – unit than these that was recently been evaluated for its use in veterinary dentistry, with this difference that this device is based on FPD – technology with an open gantry. The purpose of this study was to evaluate the potential of this new generation CBCT – device for its use in veterinary dentistry.

Cone Beam Computed Tomography (CBCT) technology

A technological review of the working of CBCT – technology was recently been presented [2, 7, 8, 9, 10, 11, 12]. In order to a better understanding of this presentation the technical principles are rapidly reviewed.

CBCT was developed due to the invention of the practical cone-beam algorithm [1], which is in fact a mathematical back projection of radiographic images obtaind around the object of scanning [5]. 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 [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 [5]. 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], [5]. 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.

Material and Methods

CBCT – scan
The heads of 4 dogs, 4 cats and 2 ferrets 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 5G™) was used in order to easily perform positioning of the isolated heads and to be able to perform scans of living animals in a later study. The isolated heads were positioned with the ventral side on the scantable. The operator had the choice between a field of view (FOV) of six, nine, twelve and 18 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, parasagittal, Multi Planar Reformatted (MPR) and dental scan reconstructions were made using the scanner software. The panoramic and parasagittal images were reconstructed by drawing a curve following the mandibular and maxillar arch for each skull 15 reformatted panoramic reconstructions were made using a slice thickness of 1, 3, 5 and 10 mm (see fig 1). Image quality was assessed on the visibility of anatomical structures including teeth, alveolar bone and canals.

<table>
<thead>
<tr>
<th>head</th>
<th>breed</th>
<th>FOV</th>
<th>kV</th>
<th>mAs</th>
<th>scan time</th>
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<td>110</td>
<td>2.02</td>
<td>3.6</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Table: Overview of scan parameters that were chosen (FOV) and scan parameters that were adapted automatically (kV, mAs, s) to scan each skull.

Results
Satisfactory image quality was obtained for the reconstructions of all the skulls’ scanned in this study. Superior detail could be assessed on the images of the different specimens. Using the reformatted panoramic reconstructions, an in detail evaluation of the dental and maxillofacial anatomy was possible. Parasagittal reconstructions through the Temperomandibular Joints (TMJ’s) were showing in detail assessment of the osseous structures. The MPR reconstructions were showing in detail assessment of the sinuses, cochlear and osseous structures of the skull. The dental scan reconstructions were showing in detail assessment of the bony structure and density in the mandibular and maxillary bone. All reconstructions were of satisfactory quality, however some informatical adaptations are still needed before this technology can easily been used in veterinary dentistry.

Discussion

This study was performed to examine the feasibility of using CBCT technology for veterinary dentistry imaging in dogs, cats and ferrets. This technology give a lot better image quality in comparison with the technology previously evaluated [7, 8, 9, 10]. Also the open gantry design is favorising its use in veterinary medicine, due to the fact that anaesthetic tubes and equipment can be better managed.

In dental medicine radiographical information is of high importance for pathologies 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 [13, 14]. 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 to better visualise the area to treat.

Conclusion

This study shows the potential that an adapted CBCT could have for studying dental anatomy and pathology of dogs, cats and ferrets. The anatomical variations of different breeds (prognathism) makes that maybe its use in veterinary dentistry have to be ruled out differently than in human medicine. For using this technology in veterinary dentistry, technological and informatical adaptations are needed. However this device is yet better adapted to its use than the CBCT device that we have evaluated previously.

References


[7] Van Thielen B., Primary Results of Cone Beam Computed Tomography in Dental Veterinary Medicine., Proceedings of the 24th Annual Veterinary Dental Forum Texas, September 30 – October 3, 2010


Sense or nonsense of CT scan in veterinary (pets) dentistry

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During the last years the diagnostic possibilities of veterinary medicine were tremendously widened. Amongst them CT and MRT. The CT scan works in general like an x-ray machine, the MRT using magnetism. Time necessary for a CT scan is significantly shorter than time for equivalent MRT-examination.

As the number of these machines rises, the question whether or not to use them arises more often, which examination is really useful for the patient and which examination is only an “amortogramm”. In canine and feline dentistry x-rays of the teeth are routine and not questioned. For cats usually 8 pictures are standard for a good survey over all teeth. With dogs this is quite different, because there are greater differences in the size (from 1 -85 kg). For a small dog the amount and type of radiographs is very similar to cats: complete portrait of all teeth; greater dogs: very often only picture of affected or suspected teeth. At lateral x-rays of scull overlapping of structures is a frequent problem.

With one single CT scan the examination of all teeth (including mandibles and TMJ) is possible, but it is doubtful if this should be a routine examination. In human medicine there exist headsscanner, based on CT-technique. These might be helpful for veterinary dentistry. The definition must be high enough: cats, rabbits and guinea pigs have a very fine bone structure and therefore high definition is required. For dogs this depends on their size: the 1 kg dog requires another scanning program than his companion of 80 kg.

CT-scans have the great advantage that certain problems can be shown 3-D. This is important for the following topics:

Examination of tumors

The expansion, the growing and situation shall be judged. This helps planning surgery, helps to decide whether to operate or not, helps with the prognosis

Fractures

Fractures may have esp. at scull and head a very complex pattern. Here it is very important which bones are affected, should there be made an attempt to reconstruct with screws and plates or may it be enough to immobilize with interlocking technique for the same result. Fractures in front part of mandibles are easily shown with x-rays, going more caudal towards the mandibular joint the diagnosis becomes more difficult. Overlapping structures of the opposite side or other parts of scull make difficulties. The same applies for the Maxilla. Fracture of symphysis is a simple subject, fractures situated more lateral may be more difficult. It may be worthwhile to balance if a CT-scan under sedation, without any rearrangement of head and body, is less harmful than x-ray examination with numerous changes of bedding. The CT-scan in this case takes less time with more details and results.

Illness of mandibular joints

X-rays of mandibular joint is very difficult and time consuming. Especially for cats and dogs there exists the problem not to see existing fractures. With a CT-scan this
Neuromuscular illnesses

Amongst them the myositis of chewing muscles shows significant alterations in CT-scan, esp. with contrast media. It makes is more ease to detect the most appropriate space for biopsy. Tumors of nerve origin are more difficult. MRT-examination may be more useful.

Foreign bodies

In or at the head there are often foreign bodies, after accident or by oral intake. Metal or mineralized foreign bodies are clearly visible on x-rays. All others can be seen only very difficult or not. Another problem maybe that abscesses can be seen late. Depending on localization CT-scan is a very useful help to differentiate abscess and tumor, and to detect the expansion and show the way for surgery. With rabbits the expansion of teeth-root-abscesses can easily be detected, esp. if there are relapses; showing how heavily the bone is affected.

CT-scan or MRT can give us very valuable assistance for prognosis and treatment. Very often this examination gives further important information - A thorough and deep-going clinical examination with dental x-rays remains very often gold standard, but if further information is required it should be reckoned if this examination is necessary and useful. Animals which had an accident profit from a relative short examination with maximum at information for treating veterinarian. Intracranial bleeding can be detected very fast.

There are two points prohibiting the wide spread use of CT -scans:
First: the cost
Second: to have or not to have an own CT/MRT machine.
For a heavily traumatized animal I would now always plea for CT scan, even if the patient has to be transported.
For diagnosis of jaw fracture, maybe not absolutely necessary . But if You have one: use it.

Literature:

4. Anjop J. Venker-van Haagen, Ear, Nose, Throat and Tracheobronchial Diseases in Dogs and Cats, Schlütersche , 2005
A Four Year Perspective on Mobile X-Ray Technology: Details on the Handheld Nomad Unit

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X-ray machine technology in the form of handheld mobile units is becoming readily available and convenient to use. This lecture highlights the use of the NOMAD X-ray unit, and offers a four year perspective for its use and application, safety, and state licensing requirements.

Portable X-ray technology has typically had its use in forensics and security screening. Advances in technology have led to hand held screening devices that are portable, relatively light weight, and battery powered. Adaptations of these units for medical use have resulted in Aribex, Inc.’s production of the NOMAD handheld dental X-ray unit (now referred to as the NOMAD eXaminer by the manufacturer when discussing veterinary applications). As of Spring 2010, Aribex reports worldwide sales of over 4000 units.

The unit retails for approximately $6500.00, and comes with two rechargeable 14.4 volt nickel-cadmium batteries with a rapid charger. Those who are familiar with the variety of handheld cordless drills and saws available at the local home improvement centers will readily recognize the style of battery packs and charger. The batteries can deliver 200-300 exposures on a single charge, and a discharged battery can be recharged in an hour or less in the appropriate DeWalt battery charger. With a properly charged battery, the unit delivers 60kV and 2.3 mA of direct current. Exposure time is the only setting to adjust, and can be increased in increments of 0.01 seconds. As a safety feature the unit is designed to shut off, and will not discharge X-rays, if the battery is not sufficiently charged. The focal spot is 0.4mm with 20cm from the focal spot to the cone tip. There is a circular, 15.8 cm (6.25”) diameter, lead impregnated, acrylic radiation backscatter shield attached to the end of the exit cone. This shield provides radiation protection equivalent to 0.50mm of lead.

When assembled with the battery pack, the NOMAD unit weighs approximately 8 pounds (primary heavy metal shielding of the X-ray source within the NOMAD tube head contributes a significant percentage to the unit’s overall weight). The lead lined 6 cm diameter exit cone assembly is held up to the patient with a large pistol grip apparatus, rather than with the articulating arm seen on conventional wall mount dental X-ray units (Fig 1). Pulling a trigger within this pistol grip activates the unit and produces the exposure. The unit can be used with conventional intraoral film, phosphor plates, or digital sensors.

This unit appears well suited for use with digital sensors. The lower radiation requirements offered by the digital technology equate to shorter exposure times and much less chance for movement and blurring of an image. Typical exposure times using digital sensors fall into the range of 0.05 seconds for cats, up to 0.09 seconds for larger dogs (Fig 2).

For the novice just learning the bisecting angle technique for producing intraoral radiographs, the NOMAD unit may present a greater challenge when attempting to visualize the angle and correctly position the cone. Wall mount and floor model dental radiology units have the standard articulating arm that allows the operator to position the tube and maintain it against the patient. The stabilized cone can be visualized from several different perspectives, and therefore provides the opportunity to evaluate and adjust the cone position before producing the exposure. If one is using digital sensors in combination with a wall mount unit, the position of
the entire set up can be maintained while the image is being displayed on a computer screen. If cone repositioning is required in order to produce a better intraoral radiograph, the spatial reference point from the previous exposure has been maintained.

This luxury is not available when producing intraoral films with a portable hand held unit. When positioning the cone against the patient, one is visualizing the bisecting angle from behind the tube head, which is an entirely different spatial perspective. Once the exposure has occurred, the unit is set down in a safe place while the image is being displayed on the computer screen. If the image is not acceptable, one must pick up the unit and reposition it based only on memory of the previous cone position. While these are minor huddles to overcome for an experienced operator, they can be sources of major frustration to someone still struggling to grasp the concept of the bisecting angle technique.

The lead impregnated acrylic shield can slide along the length of the Nomad cone, but when producing an X-ray exposure, is meant to be positioned at the very end of the cone to maximize the shielding effect from back scatter radiation. This zone of protection is produced in a triangular pattern, with the base of the triangle enveloping the standing operator. This established zone of protection is based on a horizontal position of the cone maintained when taking human intraoral radiographs utilizing parallel technique. What is not as clear is how the zone of backscatter protection is compromised as one changes the cone angle to produce intraoral radiographs in veterinary patients utilizing the bisecting angle technique.

Although the NOMAD unit has been cleared by the United States Food and Drug Administration for use as a medical device, it is important to realize that not all state radiation safety and licensing boards necessarily allow the use of the machine in a clinic setting. As a result, it would behoove one to check with the particular state in question before committing funds to purchase the hand held device.

Many radiation safety laws are written to address the use of wall mount dental X-ray units with the exposure controlled by a person using a remote trigger at least 2 meters behind the X-ray tube. The NOMAD unit is handheld and X-ray exposures are activated with a finger operated trigger by the hand holding the unit. (The unit can be mounted on a stationary stand and can be operated with the use of a corded remote trigger). Most regulations, as they are currently written, don’t accommodate the use of this newer technology. States allowing the use of this portable unit will typically require the operator apply for some form of variance in order to legally use the machine. In order for the variance to be issued, the operator must demonstrate certain precautionary measures will be met prior to making exposures with the machine.

For example, in the state of Colorado, a variance will not be issued until the operator has agreed to comply with specific requirements, namely that whole body and finger dosimetry badges are worn while producing X-ray exposures with the unit. A lead apron with not less than 0.25mm of lead protection is also required. The unit is required to have inspections on a yearly schedule. With 4 years of operation, and dosimetry reports produced every 3 months, the author has, to date, received no detectable radiation exposure from the Nomad unit. Because of the portable nature of the NOMAD unit, security is also a concern. Again, in the state of Colorado, the unit must be stored in a lockable case when not in use. If theft or loss of the unit has occurred verbal alerts must be given to the state as soon as possible (followed by written notice within 30 days if the incident).

In summary, the Nomad handheld dental X-ray unit can be easy and convenient to use. Its portability offers the ability to create exposures in any location without
depending on external power sources. The unit appears to be well adapted for use with digital sensor technology, and produces images free of blurring or movement. Its legal use is state or region dependent; expect to take extra precautions in radiation safety to satisfy regulatory agencies responsible for licensing and allowing the use of the machine.

References and Selected Reading


Atlas of Canine & Feline Dental Radiography, Mulligan TW, Aller MS, Williams CA 1998 Veterinary Learning Systems

Hardy RL, Handheld X-ray device aids dentists, Desert Morning News, Salt Lake City, May 10, 2007

Geometric accuracy of Cone Beam Computed Tomography for Veterinary Dentistry

Bert Van Thielen, Olivier Jacqmot Msc, Francis Siguenza, Bassam Hassan Phd

Introduction

The considerable potential of Cone Beam Computed Tomography (CBCT) for its use in veterinary dentistry has recently been evaluated [9 - 13]. Where the amount of radiographic information visible on conventional two-dimensional (2D) projection radiographs is often limited due to super-positioning of anatomical structures, can solve Single or Multi Detector Computed Tomography (SDCT or MDCT) this problem, but for veterinary dental clinics, the installation, operation and maintenance costs and labour of a standard SDCT or MDCT system are frequently too prohibitive in most cases. CBCT can be of good alternative for this and beside this provide in most cases a lot of reconstruction possibilities specially dedicated to dental and maxillofacial medicine, where even in human medicine, dental specific reconstructions options are very limited when using a SDCT or MDCT. And even when they are available, it means however a complementary financial investment. For all these reasons, CBCT is taught to be of interest in veterinary dentistry and is therefore been evaluated recently [9, 10, 11, 12, 13]. Concerning the image quality a lot of progress could be made using a new generation of CBCT unit which is operating with Flat Panel Detector (FPD) technology in place of Coupled Charged Device (CCD) technology [10, 14, 15]. However its shown that both CBCT units that were evaluated, CCD CBCT and FPD CBCT, are showing both a potential for its use in veterinary medicine [9 - 13]. It’s also shown that both devices need technological and informatical changes for to be operationel in veterinary medicine. However its a fact that FPD technology was superior in image quality and practical potential than the CBCT with CCD technology that was evaluated [10]. One of the reasons for this is that FPD technology have a higher detective quantum efficiency (DQE) [1, 15, 16]. Other advantages of a FPD are such as a more regular rotation field, because of the lower mass of the detector, which results in a more homogenous reconstructed FOV. A FPD have also a higher dynamic range, a higher spatial resolution, a higher linearity and the ability of more image acquisition rates [1, 14, 15].

For a in depth evaluation of the potential of CBCT in veterinary dentistry, is beside image quality also the accuracy of measurements based on imaging of high importance for the guidance of dental treatments. The objective of this presentation is to compare the geometric accuracy of 2 types of Cone Beam Computed Tomography (CBCT) scanners with the ‘gold standard’, a 64-slice Muti Detector Computed Tomography (MDCT) scanner.

Material and Methods

CBCT – scan

The dry skulls of a brachiocephalic, a mesocephalic and a doliocephalic dog were used in this study. Metallic particles, less in diameter than 0.5 mm, were glued on the skull at different places (figure). The skulls were all scanned with two different generations of CBCT devices for supine patient positioning (NewTom 3G™ and NewTom 5G™) and one 64-slice MDCT device (Philips Brilliance 64). A fixed Field Of View (FOV) was used on every scanner. The measurements obtained on the
images of the different CBCT scanners were compared with measurements obtained on the skull and the 64-slice MDCT.

Data analysis

Measurements between the metallic markers were obtained with the images in DICOM – format on a radiological workstation. Measurements obtained on the images of the different scanners were compared with measurements obtained on the skull with an electronical calliper device. The geometric accuracy for each system was evaluated using the mean error.

Results

Satisfactory geometric accuracy was obtained for all the measurements. In the middle of the FOV, the highest geometric accuracy was obtained with the newest generation CBCT. Were near the borders of the FOV, the highest geometric accuracy was obtained with the MDCT. The anatomical type of breed seems to be of no influence on the geometric accuracy of the obtained measurements.

Discussion

Beside image quality is also the geometric accuracy of high importance when using imaging for planning dental implants and procedures. This study was performed to evaluate the geometric accuracy of CBCT measurements on the skulls’ of dogs. Several studies have shown the correct linearity of CCD technology for dental CBCT [2], [3], [5], [6] and [7]. Linearity and geometry is established as correct in CBCT dental devices in order to perform maxillofacial surgery or in order to insert implants [4]. 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 [7].

Our results are in agree with the literature, however using the FPD CBCT, a higher spatial resolution is obtained in the center of the FOV than with the classical scanners. Also the anatomical type of breed seems to be of no influence of the geometric accuracy of the obtained measurements, which is technological completely logic.

Conclusion

This study demonstrates that the geometric accuracy of measurements obtained with CBCT at maxillofacial level of the dog skull is satisfactory in the objectif to plan or perform dental or maxillofacial interventions.

References


[9] Van Thielen B., Primary Results of Cone Beam Computed Tomography in Dental Veterinary Medicine., Proceedings of the 24th Annual Veterinary Dental Forum Texas, September 30 – October 3, 2010


**Evaluation of dental deposits and periodontal status in 21 small breed dogs during their first two years of life**

Boutoille F, Mariani C, Weber M, Hennet Ph, Mercier L, Biourge V.

Periodontal disease is the result of bacterial plaque accumulation on the tooth surfaces, and inflammatory and immune responses in the supporting tissues of the tooth. Twenty one dogs of small breeds (Bichon Frisé, Yorkshire Terrier, King Charles Spaniel) fed with dried expanded diet were followed during two years. Dental plaque and calculus accumulation, gingivitis and loss of periodontal attachment were regularly measured clinically and radiographically at 6, 12, 18 and 24 months. Statistic analyses were performed to assess the effect of the age and of the breed on the onset and the development of the periodontal disease.

Oral diseases have been identified as the most frequently diagnosed clinical conditions in domestic dogs (1). Periodontal disease is the result of bacterial plaque accumulation on the tooth surfaces, and inflammatory and immune responses in the supporting tissues of the tooth (2). It is more severe in small breed dogs and in all dogs the prevalence of periodontal disease increases with aging (3). Uncontrolled plaque accumulation and gingivitis may lead to periodontitis and tooth loss.

The purpose of this study was to follow the evolution of dental deposits (plaque and calculus) and the onset of periodontal disease in young small breed dogs from weaning to 2 years of age. This longitudinal study was carried out in a breeding kennel.

Results at 24 months of age are still pending, subsequently this abstract only present preliminary results. Full results will be completed by the time of presentation.

1. MATERIAL and METHODS

1.1 Material
1.1.1 Animals
Twenty two dogs: 7 Yorkshire Terriers (YT), 8 Bichons Frisés (BF), 7 King Charles Spaniels (KCS) weighting respectively 2.8±0.8kg, 4.4±0.4kg and 6.8±1.1kg at the age of one year. They had full dentition, normal occlusion (except 3 KCS with slight mandibular prognathism). Persistent deciduous teeth were extracted between 6 and 7 months of age whenever necessary. The dogs were housed by pairs with direct access to an outside area and where provided toys (the same type for all dogs) for social enrichment.

1.1.2 Diets
A dried expanded diet was distributed to each pair of dogs and water was available ad libitum. Between the ages of 2 and 10 months, a puppy pelleted diet was distributed (4185 kcalME/kg) and an adult pelleted diet after the age of 10 months (3960 kcalME/kg). The puppy pellets had a size of 8.5mm x 8.5mm x 4 mm and adult pellets a size of 11mm x11mm x7 mm. All pellets were designed with textural characteristics to avoid fast crumbling and to extend contact time with the tooth surfaces. Food intake was followed for each pair of dogs, and dogs were weighed every month during the first 6 months and then every year.
1.1.3 Teeth
For each dog, nine “target teeth” were scored: Maxillary third incisor, canine, third premolar, fourth premolar, first molar teeth and mandibular canine, third premolar, fourth premolar and first molar teeth.

1.2. Methods
1.2.1 Dental indices

On the target teeth:
- Dental plaque accumulation was assessed using the modified Logan and Boyce index (4) for the surface coverage and using the modified Silness and L̈oe index for the thickness (5). Multiplication of these two indices (surface x thickness) gave a global plaque index.
- Calculus deposits were assessed with the modified Warrick and Gorrel index (6). A first score corresponding to the surface covered by calculus was obtained and a second score evaluating the thickness was determined. Multiplication of the surface index by the thickness index gave a global index.
- Gingivitis was evaluated through bleeding on probing on the mesio/cen tro/distovestibular sides of each tooth. Normal gingival without bleeding on probing = 0, bleeding after 10 seconds = 1, moderate bleeding before 10 seconds = 2, intense bleeding before 10 seconds = 3.
- Pocket depth was measured on the mesio/centro/distovestibular sides of each tooth and loss of attachment was calculated (distance between enamel-cementum junction and bottom of the pocket).
- Furcation was assessed for each multirooted tooth (0 = no furcation, 1 = probing < 1/3 of the furcation width, 2 = probing between 1/3 and 2/3 of the furcation width and 3 = probing through the whole furcation width)
- Dental radiographs of the mandibular third, fourth premolar and first molar teeth were obtained with a size 1 CCD sensor (Sopix, Sopro®, France) to assess alveolar bone loss.

1.2.2 Experimental design
Dogs were recruited at the age of 2 months. Under general anesthesia, scores of plaque, calculus and gingivitis were measured at the ages of 6, 12, 18 and 24 months. Pocket depths and loss of attachment measurements, furcation evaluation and radiographs were performed at the ages of 6, 18 and 24 months.

1.2.3 Statistical analysis
Data were analyzed with Tanagra ® using non parametric Friedman’s test (paired data) for global age effect. When age effect was significant (p<0.05), Wilcoxon paired rank test was used for groups comparison. The global breed effect was analysed with the Kruskal-wallis test. When breed effect was significant (p<0.05), Mann-whitney test was used for groups comparison. Results are expressed as mean±sem [median].

2. RESULTS

Presented results in this abstract correspond to the scorings of 6, 12 and 18 months of age. Results for the age of 24 months are not yet available.

2.1 Dental plaque accumulation
Considering dental plaque accumulation, no age effect in each breed group was observed along the study when considering the global plaque index. A significant difference was noticed between BF and YT at the age of 18 months. YT showed a significantly higher global plaque score than BF. Results are summarized in the table 1.

Table 1. Dental plaque deposits according to the age and the breed. Results for the age of 24 months are not available for the abstract.

<table>
<thead>
<tr>
<th>Mean±sem [median]</th>
<th>6 months old</th>
<th>12 months old</th>
<th>18 months old</th>
<th>Friedman Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bichons frisés (n=8)</td>
<td>4.6±1.4 [4.4]</td>
<td>5.3±1.1 [5.7]</td>
<td>5.4±0.9 [5.7] (a)</td>
<td>NS</td>
</tr>
<tr>
<td>King Charles Spaniels (n=7)</td>
<td>5.8±1.4[5.8]</td>
<td>6.5±1.1[5.4]</td>
<td>6.1±1.1 [6.2] (ab)</td>
<td>NS</td>
</tr>
<tr>
<td>Yorkshire Terriers (n=7)</td>
<td>5.4±1.5[5.3]</td>
<td>6.8±0.8[7.1]</td>
<td>6.8±0.8[6.8] (b)</td>
<td>NS</td>
</tr>
<tr>
<td>Kruskal-wallis Test</td>
<td>NS</td>
<td>NS</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Dental calculus deposits according to the age and the breed.

2.2 Calculus accumulation
The results of dental calculus assessment according to age and breed are summarized in table 2. No difference in calculus accumulation was observed between breeds at each time period (6, 12 and 18 months). However, calculus accumulation increased significantly from 6 to 18 months of age in KCS and from 6 to 12 months of age in YT and BF.

<table>
<thead>
<tr>
<th>Mean±sem [median]</th>
<th>6 months old</th>
<th>12 months old</th>
<th>18 months old</th>
<th>Friedman Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bichons frisés (n=7)</td>
<td>0.4±0.3 <a href="a">0.3</a></td>
<td>1.1±0.4<a href="b">1.1</a></td>
<td>1.4±0.5<a href="b">1.2</a></td>
<td>**</td>
</tr>
<tr>
<td>King Charles Spaniels (n=7)</td>
<td>0.8±0.3<a href="a">0.7</a></td>
<td>1.5±0.5<a href="b">1.4</a></td>
<td>1.9±0.5<a href="c">2.1</a></td>
<td>**</td>
</tr>
<tr>
<td>Yorkshire Terriers (n=7)</td>
<td>0.6±0.4<a href="a">0.6</a></td>
<td>1.6±0.4<a href="b">1.6</a></td>
<td>1.8±0.5<a href="b">2.0</a></td>
<td>**</td>
</tr>
<tr>
<td>Kruskal-wallis Test</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Dental calculus deposits according to the age and the breed.

2.3 Gingivitis
The results of gingivitis assessments according to age and breed are summarized in the table 3. No difference in gingivitis was observed between breeds at each time period. The severity of gingivitis increased significantly between 6 and 12 months of age for the KCS and the BF, and between 12 and 18 months of age for the YT.
Table 3. gingivitis according to the age and the breed.

2.4 Pockets depth, loss of attachments and alveolar bone loss

The results of pocket depth according to age and breed are summarized in the table 4. The pocket depth measured significantly decreased for the BF whereas they increased for the KCS. For the YT, no difference in pocket depth was observed between 6 and 18 months of age.

Table 4. pocket depth according to the age and the breed.

At 6 months of age, no loss of attachment nor furcation was observed on the dogs. At 18 months of age, no furcation was observed.

At 18 months of age, 14 dogs presented a loss of attachment (6 Yorkshires Terriers-15 teeth, 6 King Charles Spaniels-21 teeth and 2 Bichons frisés-7 teeth). The measurements of loss of attachment were 1mm except for 5 teeth, for which the measurements were between 2 and 3mm. Radiographs taken at 6 and 18 months of age did not reveal any alveolar bone loss for all the dogs.

24 months results are pending.

Those preliminary results indicate difference in evolution of dental plaque, calculus, gingivitis as well as pocket depth over time between breed.
References


Common Dental and Periodontal Pathology in Dogs and Cats

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

Periodontal Disease

The periodontium is a functional unit consisting of the gingiva, periodontal ligament, alveolar bone and cementum. Periodontal disease is inflammation and infection of the periodontium due to plaque bacteria and the host’s response to the bacterial insult. Gingivitis is the reversible form of periodontal disease, affecting gingiva only. As inflammation continues, the gingiva detaches from the tooth, creating a periodontal pocket, and a shift occurs in the gingival flora from a gram-positive aerobic to a gram-negative anaerobic spectrum. Release of endotoxins and enzymes from bacteria and white blood cells is tissue-destructive. Periodontitis is the more severe form of periodontal disease, affecting all tissues of the periodontium and resulting in attachment loss, gingival recession, periodontal pocket formation and loss of alveolar bone. The loss of alveolar bone is usually irreversible, and with increasing bone loss the tooth becomes mobile and ultimately exfoliates. The goal of periodontal therapy is elimination of supra- and subgingival plaque and associated microflora and surgical reduction of periodontal pockets.

Gingival Hyperplasia

Enlargement of the gingiva is often due to gingival hyperplasia (an increase in the number of normal cells in a normal arrangement) and may result from chronic or acute inflammatory disease. Gingival hyperplasia is also caused after administration of anticonvulsants, cyclosporines and calcium channel blockers. Gingivectomy and gingivoplasty are performed to remove excess gingiva.

Dentigerous Cyst and Unerupted Teeth

The epithelial lining of a dentigerous (tooth containing) cyst around the crowns of unerupted teeth may in some cases undergo neoplastic metaplasia. Therefore, unerupted teeth should be extracted utilizing an open extraction technique, and any epithelial cyst lining should be removed and submitted for histopathological examination.

Tooth Wear

Abrasion is tooth wear caused by contact of a tooth with a non-dental material (such as a tennis ball or cage bars). Attrition is tooth wear caused by tooth-to-tooth contact (such as when a maloccluding tooth contacts another tooth). If tooth wear removes enamel and dentin faster than odontoblasts can form dentin, the pulp may either succumb to prolonged chronic inflammation or become exposed, inflamed and necrotic.

Tooth Fracture

If the fracture involves enamel only, the consequences are minimal. If dentin is exposed, bacteria could pass through dentinal tubules to the pulp. A tooth fracture is called complicated when it exposes the pulp. Crown-root fractures are fractures that
involve the crown and root(s) of the tooth. It can be uncomplicated or complicated. A root fracture is a fracture involving the root (far more common with than without pulp exposure). If uncomplicated fractures with near pulp exposure and complicated fractures are left untreated, pulp necrosis ultimately results. Canine tooth fractures are usually due to hit-by-car trauma, falls from heights, kicks and hits. Certain working dogs are more prone to fracture of canine teeth if their distal tooth surfaces are weakened by wear from chewing on cage bars. Carnassial tooth fractures in dogs are often caused by chewing on very hard objects. Tooth resorption is typically the cause of crown fracture in cats, with root fragments remaining in the alveoli.

Tooth Displacement Injury

Luxation is a clinically or radiographically evident tooth displacement within its alveolus. Lateral and extrusive luxation is most common and often associated with alveolar fracture. Intrusive luxation of canine teeth into the nasal cavity may sometimes occur in patients with severe periodontal disease. Avulsion is complete extrusive luxation, with incisors and canine teeth most often involved in dogs. The success of reimplantation of an avulsed tooth is greatly influenced by the length of time that the tooth is out of the alveolar socket. Luxated and avulsed teeth require repositioning, stabilization, and root canal therapy due to the likely loss of blood supply to the pulp.

Endodontic and Periapical Disease

Pulpitis can either be reversible or irreversible. Pulp necrosis is a sequel of an untreated irreversible pulpitis, a traumatic injury or events that cause long-term interruption of the blood supply to the pulp. When infection and inflammation spread through the apical foramina into the periapical region, periapical disease develops. A (peri)apical cyst can form when scattered epithelial cells within the periodontal ligament proliferate after chronic irritation of the apical periodontal ligament from pulpitis or pulp necrosis. If such a tooth is extracted without removing the cyst lining around the root apex, a residual cyst remains. A (peri)apical granuloma is caused by bacteria and endotoxins that leak from a necrotic pulp through the apical foramina into the periapical region, resulting in extensive demineralization of bone and radiographically evident lesions. A (peri)apical abscess can either be acute with painful, purulent exudate accumulating around the apex or present an acute exacerbation of a granuloma. Clinical signs include facial swelling, pain, and fever and general malaise in more advanced cases. An intra- or extraoral sinus tract may develop. Treatment is tooth extraction or root canal therapy.

Tooth Resorption, Tooth Extrusion and Alveolar Bone Expansion

Tooth resorption (with multiple teeth in more than one jaw quadrant involved) is very common in cats. Most affected animals will not show distinct clinical signs. Signs related to oral pain include dropping food while eating, reluctance to eat hard food, and spontaneous repetitive lower jaw motions. Tooth resorption is otherwise asymptomatic as long as the resorptive process remains below the gingival attachment (not exposed to oral bacteria) and does not affect the pulp. The cause of tooth resorption in cats is unknown, but excessive dietary intake of vitamin D has been proposed to play a role. Dentoalveolar ankylosis and replacement resorption occur when the root surfaces fuse with surrounding alveolar bone, thus including the
tooth in the normal remodeling process of bone. When replacement resorption occurs or progresses coronally towards the gingival attachment apparatus, an inflammatory component may join the initially non-inflammatory lesion. Both replacement resorption and inflammatory resorption can be present on the same tooth. In advanced stages of tooth resorption, the crown fractures off, leaving root remnants behind. Some cats show abnormally extruded canine teeth, accompanied by thickening of alveolar bone. An association between tooth extrusion, alveolar bone expansion and tooth resorption has been reported. Teeth with resorption, those with excessive extrusion, and root remnants are extracted. Ankylosed teeth and those with roots undergoing replacement resorption may be treated by means of crown amputation and intentional root retention.

Caries

Caries is the result of demineralization of the tooth surface by acids that are formed during fermentation of highly refined carbohydrates by cariogenic bacteria. It is rare in companion animals. Teeth with caries are either extracted or treated endodontically.

Malocclusion

Orthodontics deals with the diagnosis and treatment of dental and skeletal malocclusion. The goal of orthodontic treatment is to provide the patient with a pain-free and functional bite. If orthodontic treatment is performed in an intact dog or cat, neutering should be performed to prevent that the animal is bred and malocclusion inherited to offspring. Interceptive orthodontics is defined as extraction of deciduous or permanent teeth that cause malocclusion. Rather than performing extraction or orthodontic movement, the crown of a maloccluding tooth that causes trauma to adjacent structures may be reduced in length. This requires sterile instrumentation, surgical crown reduction, partial vital pulpectomy, direct pulp capping, and restoration of the pulp chamber. A direct inclined plane is utilized for treatment of lingually displaced mandibular canine teeth, with composite build up around maxillary canines and incisors and deflecting slopes made to create spaces for the mandibular canines to bite into. Buttons and elastic chains are used for treatment of mesially displaced maxillary canine teeth. The goal is to create an anchorage unit between two to three maxillary premolars and molars to ensure a larger combined root surface compared to that of the canine tooth to be moved. This can be accomplished by wiring and splinting several teeth together, forming an anchorage unit. Then orthodontic buttons are cemented to the anchorage unit and to the canine tooth to be moved. An elastic chain is placed in between the buttons.

Stomatitis

Stomatitis is a disease seen largely in the adult cat and is characterized by persistent chronic inflammation of the oral (and pharyngeal) mucosa. The etiology of feline stomatitis is poorly understood, but feline calicivirus (FCV) and feline herpesvirus-1 (FHV-1) are suspected to play an important role. Other conditions in cats and dogs that manifest as acute or chronic oral inflammation or ulceration include autoimmune disease (e.g., pemphigus vulgaris, bullous pemphigoid, discoid lupus erythematosus), erythema multiforme (e.g., perivasculitis from drug eruptions), foreign body reactions, thermal injuries, etc. Cats with stomatitis often present with a long history of difficulty swallowing, bead breath, drooling of saliva due to reluctance
to swallow, inappetence/anorexia, weight loss, pawing at the face, and pain upon eating. Oral lesions typically appear as focal or diffuse inflammation involving the gingiva, alveolar mucosa, labial and buccal mucosa, sublingual mucosa, and the mucosal region lateral to the palatoglossal fold. The goal of treatment is aimed at controlling oral plaque and decreasing the inflammatory and immunologic response. Medicinal treatment options include local and systemic administration of immunosuppressive, immunomodulatory/immunostimulatory, anti-inflammatory, antiseptic and/or antibiotic medications. Surgical treatment options include partial and full-mouth tooth extraction and laser therapy.
The importance of dental radiographs

Brook A Niemiec DVM Dip AVDC Fellow AVD

This article will cover numerous pathologies for which dental radiographs are indicated. This will prove that dental radiographs are often critical for proper diagnosis and treatment of oral disease. These conditions should not be viewed as unusual; they are present within all of our practices. Not radiographing these teeth means leaving painful/infectious pathology behind. Utilizing the knowledge gained from dental radiographs will not only improve patient care, it will also increase acceptance of treatment recommendations. Consequently, will lead to increased numbers of dental procedures performed at your practice. Finally, the information gained by via the radiographs should help smooth dental procedures.

Periodontal disease

Periodontal disease is by far the most common problem in small animal veterinary medicine. It has been reported that by the age of two, 70% of cats and 80% of dogs have some form of periodontal disease. Therefore, the vast majority of veterinary patients have probing depths which are greater than normal. Periodontal probing is an important first step in the evaluation of periodontal disease. However, there are several reasons that dental radiographs should be obtained when evaluating periodontal disease.

1) First, periodontal pockets may be missed during probing due to narrow pocket width, a ledge of calculus, or a tight interproximal space. The latter condition is quite common in the molar teeth; especially in small and toy breed dogs. Dental radiographs may elucidate these pathologic pockets.

2) Dental radiographs of periodontally diseased teeth can serve as a visual baseline to evaluate the effectiveness of professional therapy and homecare. This knowledge will help the clinician to decide which teeth should be treated more aggressively or extracted based on the trend in the level of the alveolar bone.

3) Radiographs are absolutely critical in cases of periodontal disease of the mandible of cats and small or toy breed dogs. In these patients, periodontal disease can cause marked weakening of the mandible and significantly increase the possibility of iatrogenic fracture during the extraction attempt (Fig 1). A pre-operative dental radiograph can help the practitioner to avoid this disaster. Alternatively, if a mandibular fracture does occur, the radiograph will provide conclusive evidence as to the cause.

4) When several areas of the mouth are afflicted with periodontal disease, whole mouth radiographs are indicated. This will help avoid the possibility of missed pathology which is likely painful and/or infected.

Feline Tooth Resorption (TR)

Dental radiographs are absolutely critical for proper dental care in feline patients. This is because resorptive lesions, which are very common, require x-rays for diagnostic and therapeutic purposes. Since these lesions typically initiate at or below the gingival margin, clinical evidence does not appear until fairly late in the disease course. Therefore, severe root and painful cervical crown resorption often occur undetected for long periods of time. For this reason, many veterinary dentists
recommend full mouth dental radiographs in all feline patients. Recently, one study revealed that the mandibular third premolars (307 and 407) were typically the first teeth affected. This has lead to the recommendation of starting with dental radiographs of these “sentinel” teeth in asymptomatic feline patients. If there is no clinical evidence of resorption to any tooth, and no radiographic signs on these teeth, no further radiographs are warranted. If there is any radiographic resorption to these teeth or clinical evidence of resorption to any tooth, full mouth radiographs are recommended. However, this author has often noted significant resorption to only the mandibular canines and thus tends to expose full mouth dental radiographs in all feline patients. Once a TR lesion is diagnosed, radiographs are critical to making appropriate therapeutic decisions. There are two recognized types of TRs (1 and 2). Type 2 lesions demonstrate significant replacement resorption of the roots which makes extraction very difficult. Resorption in these cases typically continues until no recognizable tooth structure remains. In these cases, endodontic infection does not occur. This finding has resulted in the accepted therapy of crown amputation for treating these teeth. Remember, ONLY if there is significant ankylosis and root resorption (no evidence of periodontal ligaments or endodontic system), is crown amputation and intentional root retention an acceptable method of therapy. In addition, patients with caudal stomatitis should not receive crown amputation. In contrast, type 1 TRs do not undergo replacement resorption. These teeth generally retain sufficient normal root and pulp structure to result in pain and infection. If the dental radiograph reveals intact root structure or worse yet an active infection (endodontic or periodontal ) then complete extraction of the root is mandated. Extraction of these teeth often requires a surgical approach to achieve complete removal due to the resorption. Armed with a diagnostic dental radiograph, the surgeon can save time by directing his or her efforts appropriately rather than delving after retained/ankylosed roots. Radiographs will also allow the practitioner to more accurately estimate the surgical time and cost of the procedure. There are no reliable clinical signs that accurately differentiate between type 1 and type 2 lesions. In addition, the degree of replacement resorption cannot be determined without dental radiographs. Therefore, without the knowledge provided by dental radiographs crown amputation therapy should NOT be performed.

Endodontic (root canal) disease

The most common instance of camouflaged endodontic disease is an uncomplicated crown fracture, where dentin but not the pulp is exposed. In the majority of cases, these teeth are vital; however there is a possibility that the endodontic system has been infected through the dentinal tubules. This can result in tooth non-vitality and infection/abscessation just like a tooth with direct pulp exposure. This painful infection cannot be diagnosed without dental radiographs. Therefore, every tooth with direct dentin exposure should be radiographed to rule out endodontic disease. Further therapy is always indicated, depending on the results of the dental radiograph. If the dental radiographs reveal no signs of endodontic disease, a bonded sealant should be performed to seal off the tooth from infection and to decrease sensitivity. The patient should have dental radiographs repeated in 9 months to ensure the tooth is/was not sub clinically infected. If there is evidence of tooth death (wide root canals or periapical lucency, root canal therapy or extraction is mandated.
Another common scenario in which teeth appear healthy but may be endodontically involved is with worn (attrition/abrasion) teeth. If there is adequate reparative (tertiary) dentin in the pulp chamber, the vast majority of these teeth remain vital and pain free. With no clinical or radiographic evidence of endodontic disease, a bonded sealant may be indicated and recheck radiographs in 9 months are recommended. It is critical to note however, that there are teeth which will are non-vital and infected in spite of visibly sufficient reparative dentin. These cases can only be elucidated by dental radiographs. If radiographic evidence of endodontic disease is present (i.e. wide root canals or periapical lucency) (See images 16 and 17), again, root canal therapy or extraction is indicated.

The final scenario of camouflaged endodontic disease are clinically normal teeth, which are actually infected. It is important to remember that infected rarely present with clinical abscessation, making diagnosis without dental radiographs impossible. The result is countless patients being chronically affected with painful/infected teeth. Not only will dental radiographs diagnose the abscess as a dental problem, it will also elucidate which tooth is causing the infection. These cases (as well as many others) prove the value of full mouth radiographs for all veterinary patients.

Persistent deciduous teeth

Extraction of persistent deciduous teeth is a very common procedure performed in veterinary dentistry. However, without dental radiographs this can be a very difficult and frustrating endeavor. If a deciduous tooth fractures, does it need to be surgically extracted or will it resorb on its own? Unfortunately, without the benefit of dental radiographs, this question cannot be answered.

In some cases, the root of the deciduous tooth is normal and is held in naturally by the periodontal ligament. In these cases, extraction is straightforward and root fracture should not occur if the extraction is performed correctly.

In most cases however, the deciduous teeth will have undergone some to significant resorption due to the pressure placed on the deciduous tooth by the erupting permanent dentition. These teeth may also be resorbing or ankylosed, but an intact root canal is often still present. The resorption and ankylosis makes extraction very difficult and will commonly result in a fractured root. In these cases, as in resorptive lesions above, a surgical approach from the beginning may be prudent. Regardless, if there is an identifiable root canal, these roots require complete extraction to avoid inflammation and infection.

Finally, there are occasional cases where the root structure of the deciduous tooth has been completely resorbed and the crown is only being held in by ankylosis at the alveolar crest. Proper therapy for this requires that only the crown and the very small retaining root segment be removed. By knowing this from the start, the practitioner saves time by not looking for the root, avoids worrying about a problem that does not exist, and does not cause unnecessary trauma to the patient.

“Missing” Teeth

It is exceedingly common for teeth to be absent in the dental arcades of veterinary patients. In some cases the tooth is truly missing, however in others, the tooth/root is present and may be pathologic. Do not assume that the tooth is not present just because it is missing or previously extracted if radiographs have not been taken of the area.

Possible etiologies for “missing” teeth include:
1. Congenitally missing (Hypo or Oligodontia):
2. Previously exfoliated (lost):
3. Fractured below the gingival margin: This condition may also result from an incomplete extraction attempt, as retained roots are far more common than most people believe. Dental radiographs will confirm a retained root and quite possibly an infectious lesion.
4. Impacted or embedded: These teeth can be malformed or normal, but do not erupt into the dentition because they are blocked by a structure such as bone or tooth (deciduous or permanent); or most commonly by an area of thick and firm gingiva called an operculum. This condition is most common in the first and second premolars of brachycephalic breeds. However, any tooth can be embedded. The biggest concern with unerupted or impacted teeth is the development of dentigerous cysts. These arise from the enamel forming organ of the unerupted tooth. The incidence of this is unknown in veterinary medicine; however, anecdotally is approximately 50%. In addition, pathologic changes were noted in 32.9% of cases in one human study.

As the cyst grows it will cause bone loss by pressure. These cysts can grow quite large in a short period of time, thus resulting in weakened bone. This will necessitate a large surgery or may cause a pathologic fracture. In addition, they can become infected and create significant swelling and pain. Finally, malignant transformation has occurred in these cases. Therapy for impacted teeth is surgical extraction. If cystic formation has occurred, en bloc removal or extraction of the tooth and meticulous curettage of the lining will prove curative.

It is critical to note that two of the causes for “missing” teeth require no therapy and the other two can lead to significant pathology. Therefore, all “missing” teeth should be radiographed to ensure that they are truly missing.

Extractions

Pre and post-operative dental radiographs should be exposed for all extraction procedures. Pre-extraction x-rays allow the practitioner to determine the amount of disease present, any root abnormalities (curved, supernumerary, ankylosis). Fully 10% of maxillary third premolars in cats have a third root. In addition, the level of remaining bone will be elucidated (see periodontal disease above). In the case of a mandibular first molar or canine extraction, knowing the amount of remaining mandibular bone can be critical to avoid a pathologic fracture. Finally, the radiographs will serve as legal evidence of the need for extraction.

Post-extraction dental radiographs are equally important. Regardless of the appearance of complete extraction, there is still a possibility of retained roots or other pathology, making post-operative radiographs critical in all cases. Finally, they will also serve as a legal document in cases of complications.
Common Oral and Maxillofacial Pathology in Dogs and Cats

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

Osteomyelitis

Osteomyelitis is a local or generalized inflammation of bone and bone marrow and usually due to bacterial or, less commonly, fungal infection. Osteomyelitis can arise from an endodontic infection, an infection through the periodontal space, an extraction wound, open jaw fracture or metastasis from a local or remote area of infection. If untreated the acute form may progress to a chronic form, eventually leading to bone necrosis. There are few anecdotal reports of multi-quadrant osteomyelitis with osteonecrosis of the jaws in dogs, and little is known about the etiology, presentation, diagnosis and treatment of this disease. Treatment involves tooth extraction, aggressive debridement and administration of systemic antibiotics.

Jaw Fracture

Traumatic jaw fractures occur after motor vehicle trauma, falls, kicks, gunshots, and fights with other animals. Pathologic jaw fractures are often secondary to periodontal disease, oral neoplasia, and metabolic abnormalities. Common sites for mandibular fracture in dogs are the premolar/molar region and the area distal to the canines. In cats, the mandibular symphysis and the condylar process are more likely involved. Fractures of the upper jaw are often multiple. Epistaxis, facial swelling, pain, and asymmetry are the usual physical findings, with or without crepitus and subcutaneous emphysema. Radiographs should always be obtained to assess tooth injuries and define fracture sites. Initially, the mouth is flushed with dilute chlorhexidine, and the fracture sites are carefully debrided. Bone fragments that could contribute to the stability of fracture repair should be retained. Healthy teeth in fracture lines also can be retained but should be monitored for any evidence of periodontal or endodontic disease. There are various ways to repair jaw fractures, including maxillomandibular fixation (e.g., adhesive tape muzzle, bridging between upper and lower canine teeth), circumferential wiring (e.g., mandibular symphysis wire cerclage), interdental wiring with intra-oral composite splinting (e.g., when teeth can be used as anchor points), osseous wiring (e.g., in edentulous areas), external skeletal fixation (e.g., in cases with missing bone fragments, severe comminution, and edentulous bone segments), bone plating (e.g., utilizing mini-, intermediate and microplates), and partial mandibulectomy or maxillectomy (e.g., when tissues are already necrotic).

Temporomandibular Joint Luxation

Trauma is usually the cause of temporomandibular joint (TMJ) luxation. With rostrocaudal TMJ luxation the involved mandibular condyle moves rostrally and dorsally. Consequently, the lower jaw shifts latero rostrally to the contralateral side. Malocclusion then results in the inability of the animal to close its mouth fully due to tooth-to-tooth contact (between the maxillary and mandibular canine and cheek teeth on the contralateral side). Reduction of rostrocaudal TMJ luxation is achieved by placing a wood dowel (or a hexagonal pencil in smaller animals) between the maxillary fourth premolar and mandibular first molar teeth on the affected side only (dowel acts as a fulcrum) and closing the lower jaw against the dowel while simultaneously easing the jaw caudally. Tape muzzling for 2 to 4 weeks will prevent
the animal from opening the mouth wide, thus reducing the likelihood of recurring luxation. Chronic luxation is treated by means of unilateral condylectomy.

Open-Mouth Jaw Locking

Open-mouth jaw locking has primarily been reported in Bassett hounds and Persian cats. Yawning often precipitates an event. The coronoid process of the mandible flares laterally, locking onto or lateral to the zygomatic arch. The animal presents with its mouth wide open, but in contrast to rostrodorsal TMJ luxation there is no tooth-to-tooth contact. An ipsilateral protuberance on the ventrolateral aspect of the zygomatic arch may be palpable. Both joints can be affected, and manual locking of the apparently unaffected side should be attempted under chemical restraint prior to surgical treatment (surgery may need to be done on both sides). Open-mouth jaw locking can also occur as a result of traumatic events that caused flattening of or excessive callus formation at the zygomatic arch, malunion fracture of the mandibular body, and increased mandibular symphyseal laxity. Acute treatment consists of opening the jaw further (sedation may be needed) to release the coronoid process from the ventrolateral aspect of the zygomatic arch, and then closing the mouth. Tape muzzling is a temporary solution. Definitive surgical treatment involves partial coronoidectomy, partial zygomectomy, or a combination of both procedures.

Temporomandibular Joint Ankylosis

Ankylosis may result from trauma to the TMJ and callus formation during healing of fractured bones forming the joint. It may also be due to extensive new bone formation associated with otitis media and craniomandibular osteopathy. Ankylosis results in a progressive inability to open the mouth. An example of a false (extracapsular) ankylosis would be the fusion between a fractured zygomatic arch and a coronoid process without TMJ involvement. Surgical treatment is dependent on the nature and location of the lesion. Radiographic features of true (intracapsular) ankylosis are loss of the TMJ space and irregular new bone formation. Treatment consists of condylectomy and excision of all associated osteophytes. Recurrence of ankylosis is common despite meticulous bone removal.

Craniomandibular Osteopathy

This disease of unknown etiology is seen primarily in 3 to 7-month old West Highland White, Scottish, and Cairn Terriers. Puppies present with swelling of the lower jaws, inappetence, lethargy and fever. They are reluctant to open the mouth and very resentful on palpation of the cranium, temporomandibular joints (TMJs) and lower jaw. Distinctive histological and radiographic features include bilateral, extensive, irregular, periosteal new bone formations along the mandibles, TMJs, tympanic bullae, and the calvarium. Long-term treatment with corticosteroids is recommended. The condition tends to run an undulant course, and symptoms may regress at about one year of age (in puppies that survive).
Masticatory Myositis

Masticatory myositis (also called masticatory muscle myositis) is an autoimmune disease that selectively involves the masseter, temporal, and medial and lateral pterygoid muscles of dogs. Inflammation, necrosis and phagocytosis are limited to the 2M myofibers in these muscles, and there is circulating IgG directed against the unique myosin component of these fibers. Acute (painful muscle swelling) and chronic stages (progressive muscle atrophy) are both associated with difficulty or inability to open the mouth. Untreated episodes may last 2 to 3 weeks. Relapses frequently occur in weeks or months. A definitive diagnosis of masticatory myositis can be made if clinical and histologic signs of inflammation are limited to the masticatory muscles, and antibodies against type 2M fibers are identified in serum and/or in immune complexes within the masticatory muscles. A 2M fiber serum antibody titer may not always be diagnostic (e.g., in dogs with chronic masticatory myositis or when corticosteroids have been administered prior to blood collection). Therefore, a muscle biopsy should be performed in addition to a 2M fiber serum antibody titer. Prednisone (1-2 mg/kg PO BID for first few weeks) is slowly tapered over 8-12 months to the lowest possible alternate-day effective dosage.

Oral Tumors

Oral tumors may be of dental (odontogenic) or nondental origin. In dogs, viral papilloma, peripheral odontogenic fibroma, acanthomatous ameloblastoma, malignant melanoma, squamous cell carcinoma and fibrosarcoma are most commonly diagnosed in the mouth. In cats, the predominant oral tumors are squamous cell carcinoma and fibrosarcoma. Incisional or excisional biopsy should always be performed in patients that present with suspicious oral lesions. Conservative resection is restricted to benign lesions. Peripheral odontogenic fibromas are likely to regrow after resection at a tissue level that does not include the tooth and its periodontal ligament from which they arise. Invasive tumors should not be treated by conservative surgery. Radical resective surgery (mandibulectomy, maxillectomy, glossectomy, lip and cheek resection) may provide a cure in many cases of oral and maxillofacial malignancy and is tolerated surprisingly well by dogs and cats. 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 tumors with local or distant metastasis.

Palate Defects

Palate defects may be congenital or acquired after birth. Congenital palate defects may appear as harelip, cleft of the lip and most rostral hard palate, cleft hard and soft palate, or midline cleft or unilateral defect of the soft palate only. Rarely, the soft palate may be absent. Acquired palate defects include oronasal fistula due to severe periodontal disease of a maxillary tooth, traumatic cleft palate often associated with falling from heights or hit-by-car trauma in cats, and lesions that result from electric cord injury, gunshot trauma, animal bites, foreign body penetration and maloccluding teeth. Clinical signs of patients with palate defects include failure to create negative pressure for nursing and poor weight gain (in immature patients), nasal discharge, sneezing, nasal reflux, rhinitis, coughing, gagging, tonsillitis, and aspiration pneumonia. Congenital hard palate clefts are repaired with an overlapping flap
technique, and congenital soft palate clefts are repaired with a medially positioned flap technique. Repair of a unilateral soft palate defect is facilitated by unilateral tonsillectomy prior to flap surgery. A medially positioned flap technique with is utilized for treatment of a traumatic cleft palate. Large caudal palate defects are repaired with a modified split palatal U-flap. Combination of overlapping flaps and buccal- or labial-based pedicle or axial pattern flaps may be required for repair of large palate defects, which are advanced, rotated, transposed and sutured across the defect 6 to 8 weeks following extraction of several teeth. These flaps are supplied by major palatine or infraorbital blood vessels. Tongue flaps may be used for defects in the rostral or mid-portion of the hard palate. Another alternative is to create a permanent or removable acrylic or silicone obturator.
Dental Radiograph Interpretation I

Brook A. Niemiec DVM Dip AVDC Fellow AVD, Jerzy Gawor DVM Fellow AVD

Interpreting dental radiographs can be daunting, but it is very similar to interpreting a standard boney radiograph. The major difference is that dental radiographic changes are often more subtle. In addition, there are pathologic states that are unique to the oral cavity. Finally, there are several normal anatomic structures that may mimic pathologic changes.

This lecture concentrates on the most common pathologies, which are illustrated by classic examples. Note that in practice, these lesions are often less obvious. The reader is directed to additional continuing education meetings to further their expertise. In addition, vetdentalrad.com is an excellent resource for questionable cases.

Determining which teeth were imaged

The first step in radiographic interpretation is determining which teeth have been imaged. This requires not a firm knowledge of oral anatomy as well as the architecture of dental films. Digital systems with veterinary templates do not require this step as long as the images are properly placed (DO NOT ASSUME THIS WAS DONE CORRECTLY). If your system does not support a veterinary template, there is a mark on the image which is in a consistent location. Review the owner’s manual for instructions on its use.

The key to properly identifying the imaged teeth is the embossed dot, which is on one corner of the film. When exposing a radiograph, if the film is properly positioned, the convex surface will point towards the radiographic tube head. There is no way to expose a diagnostic radiograph with the film in backwards, due to the lead sheet on the back side of the film. Therefore, when interpreting the film, the embossed dot is facing out of the mouth.

First, place the dot towards you (this is done for you on most digital systems). This means you are looking at the teeth as if you are the beam.

Next, rotate the film so that the roots are in their natural position (up on maxillary and down on mandibular).

Canines and incisors: This orients the film so the right side of the mouth is on the left, and right side is on the left. This is like a VD abdomen radiograph.

Molars and Premolars: Ascertain mesial from distal. If the mesial side is on the left side of the film, it is a radiograph of the left side of the patient and vice versa for the right.
Normal radiographic anatomy

There are numerous structures within the oral cavity that mimic pathologic states depending on the projection. Knowledge of normal radiographic anatomy will help avoid over interpretation.

Normal alveolar bone will appear gray and relatively uniform throughout the arcade. It is slightly more radiopaque “darker” than tooth roots. In addition, it appears slightly but regularly mottled. Alveolar bone should completely fill the area between the roots (furcation) and end at the cementoenamel junction (CEJ). The root canals should all be the same width; allowing for differences in the diameters of the root. There should be no radiolucent areas in teeth or bone. A regular thin dark line (periodontal ligament) should be visualized around the roots.

There are several normal anatomic findings that are commonly misinterpreted in dental images as pathologic. On radiographs of the mandibular cheek teeth, a thick, horizontal radiolucent line courses parallel to and just coronal to the ventral cortex of the mandible. This is the mandibular canal. In addition, there are three circular radiolucent areas seen in the area of the apices of the first three premolars, which are the mental foramina (rostral, middle, and caudal). On rostral mandibular views, a radiolucent line will be present between the central incisors. This is the fibrocartelagenous mandibular symphysis. In the rostral maxillary area: there are paired radiolucent areas distal to the intermediate incisors, which are the palatine fissures. Finally, a significant widening of the periodontal ligament at the apex of the cuspid teeth is normal. This may appear to be a periapical lesion, but is differentiated from pathology because it is very regular and v-shaped, as opposed to irregular and round.

Any questionable areas should be evaluated by exposing a comparative view. A suspicious periapical lucency (especially in the area of the mandibular premolars) should be evaluated with an additional film exposed at a slightly different angle (in the horizontal or vertical plane). If the lucency is still centered on the apex, it is likely real. If the lesion moves off the apex or disappears, it is an artifact. Suspect changes in the diameter of the root canal of a tooth should be compared against surrounding as well as contralateral teeth. Surrounding teeth can be seen on the same film with the “lesion”. The contralateral view should be taken at the same angle as the original. It is important to note that root canals are not exact cylinders (especially cuspids). A lateral view may have a much different canal width than a V/D view.
Dental Radiology Interpretation II

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This presentation will build on the first part of the lecture series. This presentation will introduce more challenging, subtle, and unusual pathologies to further define the interpretation text.

Periodontal disease

Periodontal bone loss results from the combination of bacterial induced inflammation and host response creating osteoclastic resorption of bone. This resorption will result increstal bone loss to a level below the cementoenamel junction. This decrease in bone height may also create furcational exposure. Horizontal bone loss is the most common pattern in veterinary patients is horizontal. This appears as generalized bone loss of a similar level across all or part of an arcade. The other pattern is angular (vertical) bone loss. The radiographic appearance of angular bone loss is one area of recession below the surrounding bone. The surrounding bone may be normal or be undergoing horizontal bone loss. Therefore it is common to have a combination of the two types in the same arcade.

Bone loss does not become radiographically evident until 30-50% of the mineralization is lost. Therefore, radiographic findings will always underestimate bone loss. In addition, bone loss on only on surface (i.e. lingual, palatal, or facial) may be hidden by superimposition of bone or tooth. This may resulting in a non-diagnosed bony pocket. Always interpret radiographs in light of the complete oral examination findings.

Endodontic disease

Endodontic disease may be demonstrated radiographically in several ways. An individual tooth may have one, some, or all of the different changes listed below. However, only one need be present to establish a presumptive diagnosis of endodontic disease. Radiographic changes can be broken into two major classifications: 1) changes in the surrounding bone, or 2) changes within the tooth itself.

Bony changes: The classic and most obvious finding is periradicular rarefaction. This appears as a radiolucent area surrounding the apex of a root. On rare occasions, this may also be seen mid-root, but these will virtually always be associated with periapical disease. Other, more subtle changes include a widened periodontal ligament, a thickened or discontinuous lamina dura, or even periradicular opacities. It is important to be aware of superimposed lucencies which are artifactual. These structures (i.e. mental foramina) can be imaged over an apex and falsely appear as osseous rarefaction. There are several clues that superimposed lucencies are artifactual. First, superimposed artifacts are typically seen on only one root, whereas it is very rare to find a true periapical lesion on only one root of a multi-rooted tooth. In addition, artifacts tend to be regular in appearance, whereas true periapical lesions are ragged.

If any area is in question, it is best to expose an additional film with a slightly different angle. If a periradicular lucency is still centered over the apex, it is likely real and not an artifact.
Tooth changes: The most common change in endodontic disease within the tooth itself is a root canal with a different diameter. As a tooth matures, secondary dentin production will cause a decrease in canal width. When a tooth becomes non-vital, this development stops secondary to the death of the odontoblasts. Consequently, non-vital teeth have wider root canals than the surrounding vital teeth. Conversely, on rare occasions, pulpitis may result in increased dentin production, and create an endodontically diseased tooth with a smaller root canal. This is especially common in teeth that are also periodontally diseased. This could potentially lead to a misdiagnosis of the endodontically diseased tooth as healthy and vice versa with the contralateral tooth. Hence it is important to evaluate the adjacent teeth as well as the contralateral.

Width discrepancy can be compared to any tooth (taking the size of tooth into consideration) but it is most accurate is to compare to the contralateral tooth. Endodontic disease may also be manifested radiographically as internal resorption. This results from osteoclastic activity within the root canal system due to pulpitis. These changes create an irregular, enlarged region within an area of the root canal system. Finally, external root resorption can be seen with endodontic disease. It will appear as a defect of the external surface of the root, generally accompanied by a loss of bone in the area. External resorption most commonly occurs at the apex in companion animals and is quite common in cats with chronic endodontic disease.

Feline Tooth Resorption (TR's)

TRs are the result of odontoclastic destruction of feline teeth, and are classified as either type 1 or type 2. In type 1 there is no replacement by bone, whereas in type 2 there is replacement of the lost root structure by bone.

TRs are very common in our feline patients. Studies have reported up to a 70% incidence in felines over 6 years of age! The etiology at this point is unknown. They are not bacterial in nature, although in some cases the inflammation which activated the odontoclasts may have been bacterial in nature. There are numerous theories; however none have been proven at this time. Osteoclastic resorption will generally begin at the cervical line of the tooth and progress at varying rates until in some cases no identifiable tooth remains.

Type 1 TRs are typically associated with inflammation such as gingivostomatitis or periodontal disease. Thus, they are commonly associated with periodontal bone loss on dental radiographs. In these cases, it is believed that the soft tissue inflammation activated the osteoclasts. The teeth will have normal root density in some areas and a well defined periodontal space. In addition, there is often a definable root canal in the intact part of the tooth. This type will have significant resorption of the teeth and tooth roots that is not replaced by bone.

Type 2 TRs are usually associated with only localized gingivitis on oral exam, in contrast to the more severe inflammation due to periodontal disease or gingivostomatitis seen with type 1. In these cases, the gingival inflammation is secondary to the TR. The radiographic appearance is that of teeth which have a different radiographic density as compared to normal teeth, as they have undergone significant replacement resorption. Findings will include areas with no discernable periodontal ligament space (dentoalveolar ankylosis) or root canal. In the late
stages, there will be little to no discernable root structure (ghost roots). In these cases, the lost root structure will be replaced by bone.

The importance of dental radiography in TR cases cannot be overstated. Type 1 lesions typically retain a viable root canal system, and will result in pain and endodontic infection if the roots are not completely extracted. However, the concurrent presence of a normal periodontal ligament makes these extractions routine. With type 2 lesions, there are areas lacking a normal periodontal ligament (ankylosis) which also demonstrate varying degrees of root resorption, which makes extraction by conventional elevation difficult to impossible. The continued resorption in type 2 teeth is the basis for crown amputation therapy. It is this author’s opinion that teeth with an identifiable root canal on dental radiographs MUST be extracted completely, while teeth with no discernable root canal may be treated with crown amputation. If there is any question, always err on the side of complete extraction.

Neoplasia

Neoplasia is defined as the abnormal growth of cells that is not responsive to normal growth control. Neoplasms can be further classified by their biologic behavior as benign or malignant.

Benign masses: Most benign neoplastic growths will have no bony involvement on dental radiographs. If bone involvement does occur with a benign growth it will be expansive, resulting in the bone “pulling away” from the advancing tumor leaving a decalcified soft tissue filled space in the tumor site. Bony margins are usually distinct. Finally, this expansive growth will typically result in tooth movement.

Cysts: Cystic structures will appear as a radiolucent area with smooth bony edges. Similar to other benign growths, they grow by expansion and thus displace the other structures (eg teeth). Dentigerous cysts are typically seen as a radiolucent structure centered on the crown of an unerupted tooth.

Malignant neoplasia: Malignant oral neoplasms typically invade bone early in the course of disease, resulting in irregular, ragged bone destruction. Initially, the bone will have a mottled “moth eaten” appearance, but radiographs late in the disease course will reveal a complete loss of bone (the teeth will appear to float in space). If the cortex is involved, an irregular periosteal reaction will be seen.

Histopathologic testing is always necessary for accurate diagnosis of oral masses since a variety of benign or malignant tumors appear radiographically similar. In addition, osteomyelitis can create the same radiographic findings as malignant tumors. Finally, aggressive tumors will show no bone involvement early in the course of disease. The prudent practitioner will note the type and extent of bony involvement (if any) on the histopathology request form (and may include copies of the radiographs and pictures) to aid the pathologist. It is key to interpret the histopathology result in light of the radiographic findings. A diagnosis of a malignancy without bony involvement should be questioned prior to initiating definitive therapy such as aggressive surgery, radiation therapy, or chemotherapy. Conversely, a benign tumor diagnosis with significant bony reaction should be further investigated prior to assuming that the patient is safe.

Additional diagnostic tests in questionable cases include complete blood panel, urinalysis, bacterial and/or fungal culture, as well as fungal serology.
Surgical Extractions: The Necessity, the Logic & Technique

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Indications for Extractions

Dental extractions are the most common oral surgery that the general practitioner needs to master. This is because oral disease is the most common medical problem that animals suffer which if unnoticed and not treated leads to pain and chronic suffering and debilitation. The following conditions are the most common reasons to extract teeth:

Retained primary teeth: often seen in toy breeds they cause improper eruption of the permanent teeth. There should be no two of the same teeth occupying the same space at the same time. During the adult tooth eruption if the primary is removed 90% of the adults will correct their path. If left alone the malocclusion causes soft tissue trauma and periodontal disease due to enhanced collection of plaque and calculus.

Interceptive orthodontics: This is a working Springer Spaniel with a significant “Overbite” or a Class II malocclusion. In dentistry interceptive orthodontics means extracting the teeth of the shorter jaw to remove the interlock of teeth against other teeth in the opposing jaw or against soft tissue which impedes the forward growth of the shorter jaw. In our experience it is about 25% effective often due to genetic reasons causing bone growth problems.

Supernumerary teeth: Cause often crowding and malocclusion

Periodontal disease: With the loss of attachment, the gingiva recedes, forming periodontal pocketing, loss of bone and periapical abscessation

Irreversible pulpitis: from blunt trauma the tooth turns grey from hemorrhage and as the inside pressure increases this causes pulp necrosis, periapical abscessation, granuloma formation, periapical cyst formation with bone destruction and possible mandibular jaw fracture.

Abnormal non-vital teeth: this image shows a tooth during its development dying and causing periapical bone lysis. Also visible is the horizontal impaction of the right mandibular $P_4$

Retained roots of primary teeth: cause maleruption of adult teeth or fistulization if the root fragment is large in size and does not resorb

Impacted Teeth like this mandibular $M_1$, if left impacted has a high incidence of developing into a dentigerous cyst which evolves from the periodontal ligaments of the tooth. Alternatively in this case, if the tooth root apices are still open than by uncovering the overlying gingival, this will allow the tooth to erupt since it is the root growth which is responsible for a tooth eruption.

Endodontically compromised teeth Most fractured teeth with pulpal exposures develop periapical abscessation with bone destruction. These are higher risk candidates for root canal therapy and should be extracted. This lower molar has cavities that caused severe periapical abscessation. The mesial dilacerated root is what is holding the tooth to the severely affected bone. Quite often teeth that have been subluxated by “tug of war” or “Frisbee catching” and separated from their blood supply develop a pulpitis. The crown characteristically changes its color to initially pink and then as the blood pigment in the dentin tubules breakdown to form
hemosiderin, form a gray color. All these teeth either need to either undergo root canal therapy or be extracted.

Malocclusions or the inappropriate eruption of teeth in incorrect positions, can lead to oral trauma. The most common teeth affected are the lower mandibular canines that erupt “base narrow” due to the retention of the deciduous lower canines. This condition causes the lower adult canines to erupt into the hard palate causing a permanent oro-nasal fistula. In treating the young animal with abnormal jaw positions, removing the “baby” teeth of the shorter jaw in what is called “interceptive orthodontics”, eliminates the interlock that could potentially free the forward growth of the shorter jaw. Supernumerary teeth and subsequent crowding cause often malocclusions. Regardless of what the underlying cause might be, extraction sometimes is the most appropriate alternative. Depending on the teeth involved, the approach and technique may alter.

LPGS (Lymphocytic Plasmacytic Gingivitis Stomatitis) is a condition seen in all cats although there is a breed predilection among the oriental groups and those that are FeLv/FIV positive animals. Although the exact etiology is unclear, the animal has to some degree an exaggerated response to the plaque bacteria on the teeth. Quite often the only modality that offers some help is total extraction of either the buccal cheek teeth or the canines as well

Complications:

A. Root Fractures occur mainly for the following reasons:

- Inappropriate technique since we are in a hurry to do too many things without giving ourselves adequate time.
- We use instruments that have large handles which causes us to hold them in the palm of our hands which reduces our tactile sensitivity of the force generated on the tooth
- We use inappropriate instruments for the task for example like extraction forceps so instead of first loosening the tooth with an elevator we try to exert too much force with an extraction forceps.
- Instruments are dull and not sharpened after each use. In order to compensate we use uncontrolled force to accomplish our objectives
- Teeth are ankylosed or frozen to bone which prevent movement from the weakening of the periodontal ligament
- Teeth are severely weakened from either chronic infections or tooth resorptive lesions as you can see from this radiograph where the tooth’s crown shows radiographic lucency

Diagnosis of Root Fractures is made from A. Audible “crack” sound B. root apex is rough when you touch it C. On visualization of the alveolus you can see the root remnant.

The root is yellowish in color with a central root canal visible

The sequelae of an untreated root fracture are the following

- Granuloma formation due to the underlying root retention
- Fistulization as seen with this cat on the outside of the mandible. The radiograph shows a 3P retained root fragment with a dental probe and a draining intraoral tract
- Osteomyelitis which has caused the rostral mandible to swell. This in turn has caused the swollen tissue to be traumatized by the upper canine tooth
• **Infection in the Nasal cavity** The draining tract over the missing maxillary canine and the radiograph showing the canine tooth’s retained root is seen. When a flap is lifted the thickened “cheese-like” pus is flushed out of the cavity.

**B. Dry Socket secondary to a tooth extraction** occurs for two reasons. Often the bone is severely traumatized by too much force or inappropriate instrumentation for exodontia. The clot that normally would form in the empty alveolus breaks down “fibrinolysis”. This prevents the normal healing of the extraction site and prevents epithelialization of the overlying gingiva. The animal is extremely painful. Treatment for dry socket involves extensive debridement with removal of any affected adjacent teeth. This will reestablish “bleeding bone” and a subsequent clot. This clot is stabilized and protected with a mucosal flap.

**C. Iatrogenic Jaw Fractures** often occur when the practitioner does not do preoperative radiographs and does not understand the type and extent of pathology affecting the area. Common sites of fracture are the symphysis and the interdentally space between the mandibular M1-P4 due to either ankylosed teeth and to much force or due to underlying bone weakening from periodontal disease.

**D. Hemorrhage as a complication of extractions**
- **Soft tissue laceration** occurs when the periosteal elevator slips due to improper hand support or uncontrolled force on a dull elevator. This problem can be avoided by rolling gauze and pressing it against the flap directly below where the soft tissue is being elevated and slowly rolling the instrument versus using a “push-like” stroke to lift the attached gingiva off of the tooth and underlying bone.
- **Nasal cavity penetration after elevator slips and penetrates the medial alveolus while trying to extract the maxillary canine** This problem can be avoided by placing a finger stop on the shaft of the elevator thereby preventing deep penetration if the underlying tissue is weak. Also do not quickly rotate back and forth the elevator with uncontrolled force.

**E. Broken Instruments** often occurs due to either too much force or metal fatigue. Depending where the tip separates this can make it’s retrieval very difficult. If it is in the maxillary recess often hemorrhage is brisk and requires suction to help visualize the fractured instrument tip. Radiographs at different angles with the placement of a radiodense material can help locate the position of the tip.

**SURGICAL EXTRACTION TECHNIQUES**

1. **Sever gingival attachment** Place 15c blade in scalpel handle and incise circumferentially tooth 360 degrees by inserting blade in gingival sulcus parallel to tooth root. Wedge blade between the tooth and alveolus to ensure that the attachments are cut.

2. **Create mucogingival flap** Make vertical releasing incisions one tooth on either side of the tooth to be extracted for multi rooted teeth. For the canine tooth the diverging incisions extend on the front and back surfaces from the gingival margin towards the alveolar mucosa. The cuts with one motion should extend into the underlying bone. Note Upper 4th
Premolar a 3rd incision extending from the palatal root 5-8 mm rostral (cranial) at a 30-degree angle from the tooth axis. This helps elevate the flap palatally to visualize the palatal root. Care should be taken that the angle is correct because greater than 60 degrees could sever the palatal artery!

3. Elevate the flap With a Periosteal elevator #2 or #4 Molt The flap should be carefully elevated from mesial (cranial) coronal (from crown) towards the distal (caudal) apical (towards the root). A gauze wrapped finger pressed firmly below the flap base should be used as a stop to prevent slippage of the instrument and tearing of the flap.

4. Crestal bone reduction Place a #2 round bur into the high speed handpiece and with LIGHT PRESSURE gently tighten the bur changer. As soon as the first resistance is felt STOP!!! The bur is held by friction and over tightening will damage the turbine. Using water coolant and a paint stroke action reduce the level of the alveolar bone over the tooth roots by about 25-50%.

** Note Canine teeth follow the prominent juga (bony alveolar projection over the canines) as a guide.

It is not always necessary to remove all of the facial or buccal bone to the apex of the tooth.

5. Section Multirooted teeth into individual root components Place a #701 crosscut fissure bur in the high-speed handpiece. Sectioning is performed taking the shortest, straightest path starting from the furcation toward the crown. The enamel bulge (where the gingiva use to attach to the crown) is removed to allow the drill shank to lie flat against the tooth.

Occlusal view of 4th Premolar

Mesio

Palatal

6. Create a periodontal trough Place a #1/4-1/2 round bur in the high speed. Following the periodontal space around the root made visible by removing the buccal bone, circumscribe the tooth root by enlarging this space on the front and back tooth surfaces with the drill. Use a Periosteal elevator to hold down the muco alveolar flap from being sucked into the vacuum created by the high-speed drill. This technique is especially applicable in extracting cat teeth or ankylosed teeth!
7. **Elevate out the tooth or each root segment (multi-rooted teeth)*** Using the Wiggs wing tipped elevators or the Whaledent Luxators, elevate out the roots as in a simple extraction. The elevators with a rotary action engage the root on the mesial, lingual, palatal and distal surfaces and breakdown the remaining periodontal ligaments. Luxators, with their fine blades, are used as a wedge between the tooth and the alveolus and is down along the root axis never rotational. Note hold the elevator in a slight rotating force for 10-30 seconds wherever it is placed!! Never wriggle back and forth since you will break the root!

8. **Extract and remove the loosen roots with the extraction forceps.*** **Note when elevating out the maxillary canine tooth that the crown should never be levered too far buccally. This can cause an implosion fracture to an unhealthy nasal bone plate at the apical end of the palatal alveolar wall that will create an oronasal fistula.**

9. **Debride the alveolar wall and smooth any sharp bony projections.** Use the small periosteal elevator to clean out any debris or granulation tissue in the alveolus. Using either a rongeurs or a cross-cut fissure burs in a high-speed drill the crestal bone can be further lowered.

10. **Lavage the surgical site and pack** With a curve tipped syringe and Dilute Nolvasan Solution flush the extraction site. Tetracycline powder (not in animal <1 year) Add Granules (polylactic acid), or Consil can be used to reduce hemorrhage and to support the flap if a oronasal fistula is present.

11. **Release the Periosteal flap** Using a 15c blade a superficial horizontal incision is made across the internal periosteal flap base. By holding the flap with a thumb forcep in tension as the incision is made the tissue releases and becomes more elastic. Stop at this point.

12. **Suture the flap** With a simple interrupted sutures pattern suture the corners of the flap first. Place additional sutures 2-3 mm apart and 2-3mm from the gingival edge.
The Complete Periodontal Therapy

Niina S. Luotonen DVM

INTRODUCTION

The primary cause of periodontal disease is micro-organisms, hence the goal of periodontal therapy is to control the micro-organisms and suppress the inflammation in order to obtain healthy tissues.

Every patient is unique in the extent of plaque and calculus deposition, tissue response and its effects. The examination, evaluation, prognosis and client consultation determines the treatment plan. The benefit of any professional periodontal therapy is short-lived without effective homecare. Particularly, for severe disease requiring involved procedures, owners long-term commitment for home care and continued removal of plaque is critical.

In a human patient with severe periodontitis, scaling, periodontal debridement and polishing is a pretreatment procedure. Decision on the actual treatment of existing loss of attachment is delayed for a couple of weeks until the effect of teeth cleaning is clear. In veterinary dentistry, due to the need of anesthesia, time considerations, and patient access restrictions, veterinary dentist must often diagnose and complete treatment at one session. Thus, examination made on unhealthy tissues determines need for surgical treatment.

PROFESSIONAL PERIODONTAL THERAPY

Professional periodontal therapy in animals requires general anesthesia. The gold standard for airway protection is a cuffed endotracheal tube. A throat pack prevents calculus and other debris from entering the oropharynx, larynx and trachea.

Full-mouth radiographic examination is obligatory. Scaling may be necessary before tooth examination. In a detailed examination and charting, each tooth is considered as a separate entity. Periodontal probing with a blunt end probe measures the depth of the gingival sulcus and mobility, structural normality and furcation involvement of multirooted teeth. Normal sulcus depth of the dog is 1-3mm and bleeding on probing is a sign of inflammation. Examination also includes determining the number, shape and position of the teeth – for example, supernumerary or absent teeth, rotation, crowding and functional alignment – and evaluation of furcation involvement. Dental explorer is a useful tool for determination of caries and external resorptive lesions. Dental mirror may aid in examining the palatal and lingual surfaces of the teeth. All findings should be recorded on a dental chart.

Supra- and subgingival debridement

Periodontal therapy consists of supra- and subgingival debridement by combination of mechanical scaling, hand-scaling and polishing.

Prior to scaling, the oral cavity is flushed with a dilute solution of chlorhexidine gluconate (0,12-0,2%) to reduce the general bacterial load for the patient and in the aerosol during mechanical scaling. Gross calculus is removed with calculus forceps, with care not to injure the soft tissue.
**Mechanical scaling**

Ultrasonic scalers include magnetostrictive and piezoelectric scalers which operate within 20000-40000 cycles per second. The ultrasonic scaler should always be used with a very light touch using the side of the scaler, with adequate water flow to control heat, and for maximum of 12-15 seconds per tooth, in order to avoid iatrogenic hyperthermic pulpitis.³

Sonic scalers are air-driven units operating with 3000-8000 cycles per second. Their benefit is lower heat production, thus reducing the chance of iatrogenic thermal injury to pulp.¹

Also subgingival debridement (up to 4-mm pocket depth) may be achieved with ultrasonic or sonic instruments with proper tips and irrigation, on the lowest effective power setting.¹

The fine aerorosol that develops with the use of mechanical scalers is laden with bacteria. Facemasks and protective eyewear protect the operator and assistant. A suction removes water build-up and reduces aerosolization. Antimicrobial irrigants (dilute chlorhexidine solutions) in the water source of mechanical scalers aid in reduction of bacterial aerosolization.³

**Hand scaling**

Hand scalers have a triangular blade with a cutting edge on both sides. They are used for removal of supragingival calculus with a pull-stroke away from the gingiva, to avoid lacerating epithelial attachment and not to allow bacteria to enter the periodontal tissues.³

Curettes are used for supragingival and subgingival scaling and their type must adjust with the tooth anatomy. Curettes can be of a universal or site-specific type. Gracey curettes are a useful choice for subgingival scaling and root debridement, having the cutting edge at the lower aspect of the blade. The curette must be sharp. In patients with heavy accumulation of calculus, a curette may need to be sharpened several times during the procedure.

Scaling is the process by which plaque and calculus are removed from both supragingival and subgingival tooth surfaces, while root planing is the process by which residual embedded calculus and portions of cementum are removed from the roots to provide a smooth, hard and clean surface. Overzealous root planing can remove important proteins, such as bone morphogenic protein, and slow down fibrous reattachment of the root.⁸ Endotoxins (lipopolysaccharides) from Gram-negative bacteria are present on the cementum surface only, and not within the cementum and dentine of the root as previously thought.⁹ The removal of diseased cementum or dentin is not necessary to achieve periodontal healing.¹⁰ Ultrasonic periodontal debridement removes less cementum than manual root planing with curettes: this creates less dentinal hypersensitivity and less chance of overinstrumentation.¹¹

**ANTIMICROBIAL THERAPIES**

There are two ways to use antibiotics: to avoid bacterial infection (antibiotic prophylaxis) or to treat established infection (antibiotic therapy). Antibiotic therapy is never a substitute for mechanical periodontal debridement.
Dental scaling and other oral procedures create bacteremia which healthy animals are able to overcome without the use of systemic antibiotics. However, systemic antibiotics are recommended to reduce bacteremia for animals that are immune-compromised, have underlying systemic disease such as cardiac, hepatic or renal disease, and/or when severe oral infection is present, or if the patient undergoes concurrent clean or clean-contaminated surgical procedures. Routine culture and susceptibility testing of oral pathogens in clinical work is challenging, thus the choice for antibiotics relies mostly on published pharmacokinetic and clinical studies. Amoxicillin-clavulanic acid, clindamycin, and metronidazole are effective against anaerobic bacteria and also reach therapeutic levels in the periodontal tissues.¹²

The therapeutic use of antibiotics does not form part of routine periodontal treatment and is only indicated in cases with severe, refractory periodontitis, stomatitis or osteomyelitis, and for patients with local and systemic signs of established infection i.e. pain, swelling, pus formation, fever, lymphadenopathy or an elevated white blood cell count.

Veterinary studies have shown only short-term benefit of systemic antimicrobial usage. Clindamycin hydrochloride has been used in a pulse therapy regime in the management of chronic periodontal disease. At present, there are no published data to support this therapeutic regime.³ The misuse of systemic antibiotics can cause side effects and may develop resistant strains of bacteria.¹²

Routine use of local or topical antimicrobials, such as chlorhexidine certainly has its place both prophylactically and therapeutically in helping control periodontal disease in veterinary dentistry. Bacterial resistance to chlorhexidine is unlikely, as opposed to potential resistance associated with systemically or locally used antimicrobials. However, chlorhexidine may increase staining of the tooth surface and the rate of calcification of calculus in long-term use. Extended oral contact of high concentration (>2%) can also occasionally cause painful ulcerations. In established periodontitis, chlorhexidine will not penetrate deep into the periodontal pocket and has no effect on deep subgingival periodontal pathogens.³

Locally delivered antimicrobials (periocutics) are a useful adjunctive therapy to periodontal debridement in the management of deeper periodontal pockets (>4mm). Doxycycline as a sustained release polymer is registered for use in dogs.³

HOME CARE

Home care and client education are the keys to success in the control of periodontal disease. The main goal of home care is daily removal of plaque at the gingival margin, thus preventing it from extending subgingivally. Without homecare, established gingivitis will form in 9-21 days.¹³ The gold standard for plaque removal is daily tooth brushing. Chemical agents, such as chlorhexidine gluconate and xylitol in a dilute solution, and the use of specific foods and chewing products may be of additional help in preventing plaque accumulation. Veterinary Oral Health council (VOHC) offers a seal of acceptance to the oral hygiene products and foods that have evidence based effect to retard plaque and calculus. A list of endorsed products is available on the VOHC website (www.vohc.org).³
PERIODONTAL SURGERY

Periodontal surgery should not be the first line treatment in managing periodontal disease. Surgery is indicated for deep pockets (>4mm) that have not responded to closed debridement. Periodontal surgery represents an effort to decrease the subgingival microbial load, ensure gingival attachment and prevent recurrence of periodontal breakdown. The three main surgical procedures are:

1) resective procedures - for example gingivectomy, apically repositioned flap and undisplaced flap with or without osseous resection

2) grafting and regeneration procedures – for example guided tissue regeneration¹⁴

However, without proper home care, the prognosis for periodontal surgery is poor, thus owner commitment is an essential part of the treatment plan.¹⁵

SUMMARY

The ultimate goal of periodontal therapy is to provide treatment that will arrest disease progression and give long-term stability by preventing further tissue destruction at those sites already affected, whilst also preventing disease at unaffected sites. The complete periodontal therapy consists of individually planned treatment under anesthesia, followed by regular home care.

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(Feline) Tooth Resorption

James Anthony BSc, DVM, MRCVS, Dipl. AVDC, Dipl. EVDC, Associate Professor in Veterinary Dentistry at the WCVM

▶️ History
  o First described in 1920 by a human dentist in Germany
  o Before the 70’s very few cats were diagnoses
    ▪ Poor knowledge on veterinary dentistry
    ▪ Poor oral evaluation skills by veterinarians
    ▪ Lack of dental radiographs and radiographic interpretation
  o Today’s incidence
    ▪ 32-85% of all domestic cats
      • Pure breeds 70% vs mixed 38%
    ▪ 16% of wild felidae
    ▪ Increase incidence in dog
  o Historical etiologies
    ▪ Caries (bacterial destruction of the tooth) / periodontal disease
    ▪ Diet
      • Vitamins D / A excess
      • Too much Ca or Mg or P or K
      • Ca : P ratio
      • Consistency
    ▪ Virus
      • Calicivirus, herpes virus-1, FIV, FeLV
    ▪ Systemic
      • PTH / PTHrP
      • T4
      • Diabetes mellitus
      • Chronic renal failure
    ▪ Local factors
      • Oral pH (acid reflux form hair balls)
      • Hypoxia

▶️ Current Etiology (in felidae)
  o Cats cannot synthesize vitamin D in their skin and as such rely on dietary uptake and intestinal absorption
  o Under the influence of inflammatory cytokines IL-1 and tumor necrosis factor (TNF-a), macrophages and endothelial cells increase the production and activity of 1α-hydroxylase and consequently the production of active vitamin D
  o Inflammatory cytokines (IL-6) up-regulate local active vitamin D production and active vitamin D in turn up-regulated VDR
  o Active vitamin D binds to the VDR expressed on fibroblasts, osteoblasts and osteoclasts
  o Binding of active vitamin D on the VDR of osteoblasts induces the formation of RANKL
  o RANKL then stimulated both the differentiation of the osteoclast precursors and the activity of osteoclasts
  o It is proposed that common periodontal pathogens via increasing inflammatory cytokines lead to an increased odontoclastic activity
Thus excessive vitamin D in the diet will not influence this process.

- Teeth and locations most commonly affected
  - On the labial or buccal aspect of teeth
  - Mandible: 307, 208, 309, 407, 408, 409
  - Rarely the incisors, canines, and maxillary molars

- Clinical signs
  - Oral pain
    - Mandibular quivering
    - Teeth chattering
    - Yawning
    - Pawing at the mouth
    - Rubbing face
  - Hesitant to pick up food
  - Drops food
  - Inappetent / anorexia
  - Weight loss
  - Water temperature preferences
  - Nothing

- Diagnosis
  - Tactile evaluation with a periodontal probe
  - Surface defects and irregularities
  - Visually can see red inflamed granulation tissue over the crown of a tooth
  - Dental radiographs
    - Determines the true extent of the lesion
    - Reveals 98.4% additional information on the extent of the lesion vs. clinical examination
    - 8.7% of cats without clinical signs had radiographic signs
    - Can see
      - Radiographic lucent areas on the tooth
      - Indistinct lamina dura and periodontal ligament

- Classification of lesions
  - Type 1
    - Peripheral inflammatory root resorption
    - Inflammation is primary or secondary
    - Due to periodontal disease(?)
  - Type 2
    - Replacement resorption
    - Non-inflammatory
    - Dentoalveolar ankylosis

- Classification of stages
  - Stage 1
    - Mildly affecting the cementum and or enamel
  - Stage 2
    - Progression into dentin (no pulp exposure)
- Moderately affecting the cementum and or enamel
  - Stage 3
    - Progression into the pulp
    - Tooth still retains integrity
  - Stage 4
    - Extensive cementum enamel and dentin loss
    - Extends into the pulp
      - A) crown and root equally affected
      - B) crown worse than root
      - C) root worse than crown
  - Stage 5
    - Crown is absent
    - Remnants visible
    - Gingival covering the area where the tooth was/is
    - Irregular radiopacities on radiographs

❖ Treatment
  - Extraction is the most common treatment
  - Restoration are possible but offer poor success rates i.e. 10% long term
  - Stage 1
    - NYAG laser
    - Oral hygiene
    - Root planning
    - Sealants
  - Stage 2
    - Extraction
    - NYAG laser
    - Restorations?
  - Stage 3
    - Extraction
  - Stage 4
    - Extraction
    - Atomization (burring out the root remnants with a high speed bur and copious amounts of water)
    - Crown amputation with intentional root retenion
  - Stage 5
    - No treatment if the gingival is healthy
    - If the gingival is inflamed atomization

❖ Postoperative treatment
  - Antibiotics
  - Anti inflammatories
  - Pain control
  - Recheck in 2 weeks
    - Implement a home care program for plaque control
  - Regular re checks (at least every 6 months)
    - Oral hygiene procedures when required
Developmental dental disorders in dogs

Leen Verhaert, DVM, Dipl. EVDC

Developmental disorders of teeth in dogs are common. They include defects in number, defects in size, defects in shape and defects in structure. Many of these are mainly cosmetic, but some may cause serious clinical problems. Developmental dental disorders may be inherited, or they may be caused by insults during tooth development. The most common disorders will be discussed in this review, including clinical significance and treatment options.

INTRODUCTION

Developmental dental disorders may be due to the differentiation of the dental lamina and the tooth germs, which leads to anomalies in number, size or shape. Abnormalities in the formation of the dental hard tissues lead to anomalies in structure. Developmental dental disturbances may be inherited, but they may also be acquired or idiopathic. Clinical importance of any defect varies from insignificant and mainly cosmetic, to extremely significant and leading to pulp necrosis and abscess formation. Since developmental dental disturbances are regularly seen, and may very well be hardly recognisable by clinical examination, radiographs in dentistry are of utmost importance.

VARIATIONS IN TOOTH NUMBER

Decrease in number: anodontia - oligodontia - hypodontia Anodontia (congenital absence of teeth) and oligodontia (only a few teeth present) are rare conditions, often associated with generalised disorders such as ectodermal dysplasia. Hypodontia (one or a few teeth missing) is a common condition. Hereditary factors are often involved in the congenital absence of teeth. Teeth can also be missing as a result of disturbances such as trauma or infection during initial development. Hypodontia in the permanent dentition is more frequent than in the primary dentition. When a primary tooth is congenitally missing, its permanent successor is usually missing too. Premolars and incisors are the most frequently affected teeth. Radiography is essential to differentiate missing teeth from impacted and embedded teeth. Clinically hypodontia is mainly a cosmetic issue. Differentiation between possible hereditary and proven traumatic causes is important for breeding dogs.

Increase in number: supernumerary teeth - hyperdontia Extra teeth can occur in the primary and/or the permanent dentition. Supernumerary teeth may be inherited, but this condition can also be caused by disturbances during tooth development. It is seen most often in the incisor and premolar region. Supernumerary teeth can, but do not necessarily, have a normal shape and size. Supernumerary teeth may cause disturbances in eruption, crowding and deviation of adjacent teeth. In these cases extraction needs to be considered. Preoperative radiographs are mandatory. The owner needs to be advised of the possible heritability of the disorder.
Impacted teeth
An impacted tooth is a tooth which fails to erupt into its normal position because of some physical barrier in the eruption path (usually another tooth). Generally this is an acquired condition but it can be genetic. Impaction can be caused by trauma or simply because the tooth’s position in the alveolus is abnormal, or the tooth’s shape is so abnormal that it is unable to erupt into its normal position.
Impacted teeth need to be differentiated from missing teeth. Radiographs are therefore indicated. Impacted teeth should be treated or at least monitored on a regular basis. Depending on the presenting problem, treatment may consist of removing the overlying gingival tissue (operculectomy), or removal of the tooth.
Impacted teeth may cause resorption of the roots of adjacent teeth. In man, periodic pain due to tooth impaction has been described. A dentigerous cyst may develop around the coronal portion of the tooth. Furthermore, cases of ameloblastoma have been reported to develop in the wall of these cysts.

ALTERATIONS IN SIZE

Alterations in the size of teeth are of limited clinical importance in dogs. Teeth that are smaller than normal are referred to as microdont. Macrodont teeth are teeth that are larger than normal, and these may interfere with normal occlusion.

ALTERATIONS IN SHAPE

Gemination and Fusion
Gemination is defined as an attempt to make two teeth from one enamel organ. Occasionally complete cleavage or twinning is seen (two teeth from one enamel organ). Gemination is seen most often in the incisor region.
Fusion is the joining of two tooth germs, resulting in a single large tooth. Fusion may involve the entire length of the teeth, or only the roots, depending on the stage of development of the teeth at the time of the union. The root canal can be shared or separate.
The aetiology of gemination and fusion is unknown, but trauma and a familial tendency both have been suggested as a possible cause. Both can be seen in the deciduous as well as in the permanent dentition.
Concrescence
Concrescence is the fusion of adjacent already formed teeth by cementum. It may take place before or after eruption. It is a form of fusion, where the teeth are united by cementum only. It is thought to arise from trauma or crowding of teeth.

Dilaceration
Dilaceration refers to a sharp bend or curve or angulation in the root or crown of a tooth. The cause is usually acute mechanical trauma during the development of the tooth. The curve or bend may occur anywhere along the length of the tooth.
A dilacerated crown may be an aesthetic problem. Often the surface of a dilacerated crown is irregular, leading to a highly plaque retentive surface. Extraction or endodontic treatment may be difficult in case of a dilacerated root. Severely dilacerated teeth may be unable to erupt.
Dens invaginatus - Dens in dente – ‘Tooth within a tooth’
Dens in dente is an uncommon tooth anomaly, with only a few cases described in the veterinary literature. It represents an invagination of enamel and dentin towards the pulp of the tooth.
The clinical significance of dens in dente depends on the severity of the lesion, varying from higher caries susceptibility to pulpal necrosis and periapical inflammation.

Supernumerary roots
Accessory roots can be seen in dogs. Most commonly involved is the upper third premolar in the dog.

STRUCTURAL DEFECTS OF ENAMEL

Amelogenesis imperfecta is a hereditary form of enamel defects which affects both dentitions. The incidence in dogs is unknown, but it has been reported in the Standard Poodle.
Environmental enamel defects are commonly seen in dog’s teeth. Enamel develops in 2 stages: a secretory stage (matrix production and early mineralization) and a maturation stage (increase in mineral content by withdrawal of water and protein). In enamel hypoplasia, the enamel is quantitatively defective (insufficient amount but normal hardness). Qualitatively defective enamel (normal amount but hypomineralized) is referred to as enamel hypocalcification. Some disturbances affect both matrix formation and mineralization.
Aetiologic factors may occur locally or systemically. Examples of etiologic factors include: vitamin deficiencies (rickets), epitheliotropic viruses (e.g. distemper virus), hypocalcaemia, excessive fluoride ingestion, local infection, local trauma. Sometimes no apparent cause can be identified (idiopathic). The extent of the defect(s) depends on the intensity of the aetiologic factor, the duration of the factor’s presence and the time at which the factor occurs during tooth development. Any serious nutritional deficiency or systemic disease is potentially capable of producing enamel defects in the areas of the teeth that are being formed at that time.
Clinical presentation varies. In the hypoplastic type, the enamel is irregular, pitted or thin and may even be absent, but what is present has a normal hardness and colour. In the hypocalcification type and the hypomaturing type, there is a normal amount of enamel, but calcification is deficient. The enamel is relatively soft, becomes discoloured, and wears away readily, and this more rapidly and severely in the hypocalcification type as in the hypomaturing type. The colour of the teeth varies from white opaque to yellow to brown. Affected teeth tend to darken with age, due to exogenous staining.
Treatment options include restoration of the defect (in localised forms) and sealing of the dentin tubules. Since affected teeth have a very irregular, plaque-retentive surface, good oral home care (daily toothbrushing) is very important.

OTHER STRUCTURAL DEFECTS

Very few reports exist in veterinary literature regarding other structural defects. Dentinogenesis imperfecta, an inherited dentin defect, has been described in the dog. The dentitions have a blue-to-brown discolouration, often with a distinctive translucence. The enamel frequently separates easily from the underlying dentin. Deciduous teeth are affected most severely. Prognosis for retention of teeth is not
good, due to severe attrition, microexposures of pulp and periapical inflammatory lesions.

FURTHER READING

Temporomandibular Joint Disorders in Dogs and Cats

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

Introduction
Temporomandibular joint (TMJ) disorders more commonly encountered in the cat and dog include luxation, open-mouth jaw locking, and ankylosis. Luxation of the TMJ is often confused with open-mouth jaw locking. Both conditions may present with inability to close the mouth, but their causes, manifestations and treatments differ. A diagnosis is made by means of clinical examination and radiography (e.g., dorsoventral view). Luxation of the TMJ can usually be resolved with a pencil placed between the maxillary and mandibular carnassials and then closing the mouth. However, the same treatment modality is impractical and will cause further trauma and pain to the patient with open-mouth jaw locking. Trauma to the TMJ in young animals may lead to joint ankylosis and progressive inability to open the mouth.

Temporomandibular Joint Luxation
Luxation of the TMJ occurs as a result of trauma, with mandibular condyle usually displaced in a rostrodorsal direction. The lower jaw then shifts forward and to the contralateral side, resulting in the inability of the animal to close its mouth fully due to abnormal contact between the maxillary and mandibular teeth. Caudal displacement of the mandibular condyle is rare, but may occur with fracture of the retroarticular process of the temporal bone. Radiographic examination facilitates diagnosis of TMJ luxation. A dorsoventral radiographic view will show increased width of the joint space and (rostral) displacement of the mandibular condyle. Lateral oblique views are also useful in establishing a diagnosis. Reduction of rostrodorsal TMJ luxation is achieved by placing a pencil between the maxillary fourth premolar and mandibular first molar teeth on the affected side only and closing the mouth. Following reduction the TMJ capsule may be lax and the mandibular condyle unstable. A tape muzzle for 2 to 4 weeks will prevent the patient from opening the mouth wide, thus reducing the likelihood of recurring displacement. Chronic luxation is treated by condylectomy.

Open-Mouth Jaw Locking
Dysplasia of the bony and/or soft tissues of the TMJ is congenital or acquired during life and has primarily been reported in Persian cats and dogs such as Bassetts. It may result in increased laxity of the TMJ capsule and open-mouth jaw locking. Yawning often precipitates an event. In contrast to rostrodorsal TMJ luxation, there is no contact between maxillary and mandibular teeth, and the patient presents with its mouth wide open. A dorsoventral radiographic view will reveal the coronoid process of the mandible having flared laterally, locking onto or ventrolateral to the zygoma. Computed tomography is of academic interest and may not be necessary to make a diagnosis. An ipsilateral protuberance on the ventrolateral aspect of the zygomatic arch may be visible or palpable, particularly in very lean patients. Locking occurs on the opposite side of the dysplastic joint. However, both joints can be affected, and manual locking of the apparently unaffected side should be attempted under sedation or anesthesia prior to surgical treatment. Open-mouth jaw locking can also occur without TMJ dysplasia as a result of trauma. Acute open-mouth jaw locking is treated by opening the mouth further to release the coronoid process from the ventrolateral aspect of the zygoma, and then closing the mouth. Tape muzzling is a temporary solution. Definitive treatment involves partial coronoidectomy, partial zygomectomy,
or preferably a combination of both. A curvilinear incision is made parallel to the zygoma, muscle attachments are dissected from the bone with a periosteal elevator, and the coronoid process locked ventrolateral to it is identified. A segment of the zygoma and a portion of the coronoid process are removed with a rongeur, followed by closure of the surgical site.

**Temporomandibular Joint Ankylosis**

Progressive inability to open the mouth usually occurs as a complication following trauma to the TMJ particularly in immature, adolescent or young adult cats and dogs. If long-standing in immature animals, growth of the lower jaw may be retarded, resulting in mandibular distocclusion (mandibular brachygnathism).

True (intracapsular) ankylosis is defined as fusion of bony tissues within the TMJ capsule. This may occur after fracture of the condylar process of the mandible and/or fracture of the mandibular fossa of the temporal bone. Radiographic signs include loss of the TMJ space, irregular or unrecognizable mandibular condyle contours, and new bone formation. This condition is treated by means of condylectomy and excision of any callus (which often extends extracapsularly). It may sometimes be helpful to transpose adjacent muscle tissue or to pack fat transplants into the surgical site to reduce the likelihood of reankylosis. Postoperative care should include physical therapy in the form of repeated mouth opening by the caregiver several times a day and administration of corticosteroids that slow down the callus formation capacity of bone. Oral prednisolone is given at 1-2 mg/kg daily divided in two doses for one week and then tapered to 0.25-0.5 mg/kg once a day over a 4-week period. Injection of repository triamcinolone into each surgery site can be used if oral prednisolone is not satisfactory.

Extensive callus formation during healing of fractures of the zygoma and mandibular ramus can also lead to progressive inability to open the mouth without TMJ involvement. Such false (extracapsular) ankylosis may also be a sequela to new bone formation associated with unilateral separation of the temporal bone from the parietal bone (the latter may often go unnoticed), craniomandibular osteopathy, and otitis media. Surgical treatment is dependent on the nature and location of the ankylosis lesion and often requires resection of zygoma, mandibular coronoid process, mandibular condylar process and excessive new bone.

**References**

Comparative Conventional Endodontics

Peter Emily DDS, Hon. AVDC

Overview

Comparative Endodontics as we know it is the comparative pathology diagnosis, instrumentation, and varied treatment modalities of those species that have an endodontic system. The objectives are the same - the elimination of pathology and the restoration of function – and are the only things that they all have in common. The procedures can follow similar lines in most cases, but can vary greatly in treatment approaches and medicaments. Vital pulpotomy are rarely performed in many species.

Etiology of Pulpal Pathology

Inflammatory process is the complex vascular, lymphatic, and pulpal reaction to inflammation and infection. Pulpal pathology is most commonly the result of trauma, attrition, caries, dental resorption, anachoresis, or of iatrogenic etiology.

Anachoresis

Anachoretic pulpitis by definition is the haematogenous spread of infection to endodontically compromised teeth. The condition is reversible in cases of hyperemia or mild pulpitis. Advanced serious or suppurative pulpitis results in pulpal death. This is one of the most common causes of pulpal pathology in equine and other large herbivorous.

There are basically three species and treatment choices:

1. Carnivores
2. Herbivores
3. Primates

Carnivore Endodontics.

Conventional veterinary endodontics must deal with all species. Carnivore endodontics are presented with macro or micro dentition. Root canal length varies from 1 to 8 centimeters.

The primary concern with most carnivore endodontics is instrumentation. Large carnivores, such as lions and tigers present root length of 7 to 8 centimeters from gingiva to apex. Most carnivores have closed apices. Long endodontic files of 120 mm are essential for lions, tigers, bears etc. gutta percha of these lengths are not available. A master cone made up with (2) two 60 mm gutta percha points fuzzed together from the tip of one to the end of another is inserted to depth, after root canal sealer has been placed. Lateral condensation performed with additional like GP points complete canal obturation. A heated gutta percha technique may be utilized. The softened Gutta percha can be inserted into the canal in small amounts and quickly condensed apically with the new long PEIVDF plungers and spreaders.

Primate Endodontics
Primate dentition is similar to humans. Primate teeth have open apices. Therefore after access, a primary endodontic file is placed to the estimated apex, radiographed, and adjusted for length. The file tip should be 0.5 mm from the radiographic apex. All subsequent files of canal preparation are then inserted to the measured length. After preparation, a master cone is placed before cementation and again radiographed for proper length, adjusted if necessary and then cemented to place.

Herbivore Endodontics

Conventional endodontics in herbivores is generally conducted on incisor and some canine dentition. Premolar and molar endodontics is conducted surgically. Incisor access depends upon tooth condition. Coronal fractures are accessed directly through the fracture site. Access can also be made intra-orally at the base of the tooth in question or entered 3 to 4 mm from the gingival margin with a 4 to 6 round bur directed toward the apex. Conventional therapy is conducted similar to primate root canal therapy with open apices.
The use of rotary files in endodontic treatment

Paul Theuns  DVM

Introduction

Several types are commercially available nowadays. I will give a short overview of rotary files that are used in veterinary dentistry. Nickel titanium has made the development of new instruments possible. These files follow the root canal and prevent ledging.

We need to take under consideration that we copied the endodontic procedures from human dentistry books. The anatomy of the root differs from the human teeth. The animal tooth root is difficult to properly get cleaned with the traditional files. Rotary files will help to overcome part of these difficulties, they will improve the cleaning and shaping of the canal and will also decrease the time needed to complete the root canal treatment. The disadvantage of rotary files is that they are technique sensitive, a busy veterinarian easily takes a shortcut that can predispose to a broken file. Bear in mind that most rotary files turn at a slower speed than most of the slow handpieces. For rotary files a 10:1 or greater is needed.

Equipment

Motors

Electric motors with gear reduction are more suitable for rotary NiTi systems than are air driven systems because they ensure a constant rpm level. However they deliver a much higher torque than needed to break a file. Torque controlled motors are believed by some authors to reduce the risk of breakage, but these motors are unlikely to reduce the risk of fracture caused by the cyclic fatigue. For rotary instrument tips, susceptibility to breakage is governed by the quotient of torque needed to fracture divided by working torque. Simply put, the larger the value, the safer the file. The LightSpeed system comes with it’s own battery operated motor with hand piece.

Files

Most rotary techniques requite a crown down approach to minimize torsional loads and to reduce the risk of instrument fracture.

Gates-glidden burs can be used sequentially to enlarge the coronal third of the canal in teeth with straight roots. Both step back and step down sequences have been recommended. Besides Gates-glidden burs various instruments have been introduced or suggested for coronal preenlargement, such as the ProFile orifice shapers, Gt accessory files, the ProTaper Sx, the Flexmaster intro file, and the size #40, #.10 taper or size #35, #.08 taper RaCe files. These instruments are better and safer for more difficult cases. NiTi rotary instruments are an invaluable adjunct in the preparation of root canals, although hand instruments may be able to enlarge canals just as efficiently when used in appropriate sequences.

Instrumentation
Access Preparation and pulp contents removal can be done in the traditional way. So after coronal enlargement with the instrument of choice, the apical canal is instrumented until the minimal file size is reached for the specific rotary file to be used. The clinician should always read the manufacturers instructions for details on working with those instruments. That being said it also must be noted that these instructions not necessarily have to be evidence based.

**Light Speed**

When using the Light Speed system, the files are introduced manually in the canal continually rotating, with a slow continuous apical movement until the blade binds. After a momentary pause, the blade is advanced to the working length with intermittent pecking motions. The number of pecks (up and down movement) required to reach working length increases as the instrument size increases, because more wall dentin is cut. The instrument that requires 12 or more pecks (12-peck rule) to advance from the point of first binding to the working length is the master apical rotary size (MAR). An instrument one size larger than the Mar then is used to instrument to a length 4 mm short of the working length. Before each file is introduced in the canal, the canal is irrigated with EDTA (ethylenediaminetetraacetic acid). Between each 3rd file size the canal is flushed with NaOCl... Then the coronal part of the canal is enlarged using the step back method. Using the next size rotary file the canal is instrumented to a 4 mm step back from the working length. Continue with stepping back with sequentially larger full size instruments until a size is reached that cannot be easily advanced beyond the coronal third. Finally the MAR is used to recapitulate to the working length. The LightSpeed instruments should be used in a handpiece that rotates at 2500 rpm. LightSpeed instruments are designed with 2 blades that have neutral rake angles. The radial lands keep the instrument centered in the canal while the blunt instrument tip prevents it from cutting or gouging the canal walls. LightSpeed are very flexible which allows them to negotiate and clean curved canals. There is also an option to use them by hand in extreme curves.

**ProFile**

Many different techniques have been advocated for the ProFile, but the general pattern remains a crown down approach with varying tapers and tip diameters. The working length then is determined as described previously, and an open glide path is secured with K-files up to size #15 or #20, depending on the canal anatomy. If canal size permits, canal preparation begins with #.06 taper instruments in descending tip diameters. In more difficult smaller canals #.06 tapers are followed by #.04 instruments, also with descending tip diameters. Apical preparation is performed either with multiple shaping waves or in a step back manner. Because of their superior resistance to cyclic fatigue, #.02 ProFile instruments are useful for abrupt apical curves. Preparation is complete once a continuous #.06 taper with an adequate apical size is achieved. Recapitulation during the preparation with a small hand file is recommended.

**ProTaper**

The approach for ProTaper instruments differs from that for most other NiTi rotary files in that no traditional crown-down procedure is performed. Size #10 and #15
hand files are precurved to match the canal curvature and then passively inserted into the coronal 2 thirds of a root canal as a path-finding files, which confirm the presence of a smooth, reproducible glide path. This step is essential for ProTaper shaping instruments, because they are mostly side cutting and have fine, fragile tips. Than the ProTaper shaping files S1 and S2 are carried to the full working length. The working length should be confirmed after irrigation and recapitulation with a K-file, aided by radiographs. Because of the progressive taper and more actively cutting flutes higher up in the ProTaper design.

Obturation

Obturation can be done with traditional gutta percha or with a simply fill plug.

Sealer

Different sealers can be used. The LightSpeed manufacturer recommends using AH plus sealer when using gutta-percha plugs. This 2-component sealer is biocompatible and adapts closely to the canal walls. It also provides minimal shrinkage, long-term dimensional stability and outstanding sealing properties. It has a 4-hour working time and sets in eight hours.

Discussion

The benefits of using a combination of instruments for endodontic therapy are;

1 Instruments can be used in a manner that promotes their individual strengths and avoids their weaknesses.
2 Hand instruments secure a patent glide path
3 Tapered rotary instruments efficiently enlarge coronal canal areas
4 Less tapered instruments allow additional enlargement

However this will increase the financial investment of the equipment considerably.

Conclusion

Summarizing this, one could consider using the NiTi files of different branches. One set to enlarge the coronal third and one set from another brand to work on the apical third. Veterinarians have to realize that the LightSpeed system allows for the use of longer (50 mm) rotary files for use in the canine teeth. Because rotary files make easier faster and safer access of the canal possible, they are a welcome extension to the dental instruments for the veterinarian practicing endodontics on a regular base.

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3 19th veterinary dental forum and world veterinary dental congress IX, Bob Boyd, how to improve tha quality and speed of your root canal treatments with LightSpeed rotary instruments, pp. 49-51
Comparative Surgical Endodontics

Peter Emily DDS, Hon. AVDC

Surgical endodontics is the treatment of choice where there is a history of recurrent facial swelling, the existence of anatomical or morphological problems, unresolved granulomatous tissue, or sequelae remain after conventional endodontic therapy, posterior herbivore dentition, or problems encountered during conventional endodontic therapy, such as, fractured endodontic files or incomplete endodontic fill.

Approximately eighty five percent of surgical endodontics in carnivores are the result of conventional endodontic failures. Surgical endodontics should be the treatment of choice when unknown apical morphology may exist, or repeated inductions would be a surgical risk necessitating a one-time procedure for remission such as seen in exotic animals. Failed conventional endodontics most often is the result of incomplete apical fill or seal, incomplete removal of pulpal contents, failure due to fractured and retained endodontic files, or other idiopathic and iatrogenic causes. The most frequently involved tooth is the upper fourth premolar (usually the lateral rostral root), followed in frequency by the lower canine, and then upper canine.

Instrumentation

Conventional basic instrumentation consists of a high-speed or slow-speed dental hand piece, a number 1/2 or 1 round bur, a 699 or 700 tapered fissure bur, I.R.M, Super E.B.A or MTA cement, a number 15 scalpel blade, and 4/O sutures.

Comparative Procedures

Procedures vary within species. The surgical procedure for most carnivores is relatively the same, in that the access sites, flap construction, apex accesses and preparation, and retrograde fill are basically the same. However, in cases where fistulating tracts are present in exotic carnivores, treatment should be completed in one event, because of the risk of repeated anesthetic induction. Therefore, conventional as well as surgical endodontic therapy should be performed, to avoid possible conventional endodontic failure, necessitating another anesthetic induction.

Surgical endodontics varies in herbivores. Access sites for premolars and molars can be either intra-oral or extra-oral. Apical access often is best achieved by following the draining tract of the fistulas of the canine, premolar, or molar involved.

Unfortunately most cases of herbivore endodontics are often misdiagnosed. Pathology usually becomes advanced before treatment. Treatment is generally extraction for lack of knowledge of endodontic therapy. The difficulty arises in accessing the right tooth. In equines, teeth slant slightly to the distal, often presenting difficulty with alignment.

An intra oral x-ray with a probe, root canal file or an explorer placed at the suspected apex, or a gutta percha point placed into a draining fistula, when radiographed will help to locate the access point.
The canals are obturated with one of three cements: IBM, Super EBA, or one of the Portland cement preparations. Silver amalgam, as used in the past is contraindicated due to a poor apical seal, and poor retentive properties.

Other herbivores such as llamas and alpacas often present other problems and treatment modalities. There is a wide variation in endodontic systems and root morphology. Preoperative radiographic diagnosis for these variations is essential. Although it may be a rather false impression, the posterior dentition seems morphologically mixed in some herbivores, that is Hipsodont and Brachydont dentition in the same quadrant, as seen in alpacas.

While equine premolar and molar form is more consistent, there is a tooth age consideration when a single root is involved. A tooth under four or five years of age has a communicating canal between roots. This necessitates surgical endodontics on both roots, whereas a tooth past five years of age usually needs surgical endodontics only on the involved roots.
An invisible risk - embedded teeth in brachycephalic dogs

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Brachycephalic dogs are increasingly popular with their extremely shortened facial bones they fulfill the small child pattern. This “ideal of beauty” brings some health problems. The brief skull offers the eyes, the turbinates and the genetically not adapted teeth inadequate space. Shortness of breath, exophthalmos and periodontal diseases are the result. One should assume that each missing tooth is an advantage. But how can one be sure that the tooth is really missing? Each apparently missing tooth can be created anyway. It can be embedded in the jaw. Any embedded tooth is a danger. The enamel organ can’t be wiped out and there is a risk of fluid formation by the epithelium. The resulting cysts can assume enormous size, it can cause jaw fractures or damage to other important structures. In computed tomography of 319 brachycephalic dogs we saw a cluster of tooth retention and cyst formation, compared to mesocephalic control group. Pugs show, for example, in the median only 36 teeth, missing teeth, then, are the rule. 58% of all investigated pugs show embedded teeth. Without X-ray examination it is not possible to differentiate between missing or embedded therefore not possible.

Introduction

Brachycephalic dogs show due to their genetic reduction of the facial skeleton not only morphological and functional changes of the upper respiratory tract, but they show a change in the shape of dental arches (Arcus dentalis) and complex dental anomalies. Some dental abnormalities may promote periodontal diseases; others lead to instability of the jaw or relocation of airways. Rotation (1) and crowding of the molars and premolars (2) are common and easy to see in the physical examination. Crowding and rotation of the teeth lead to the formation of so-called dirty niches and favors the development of periodontitis. The clinical image of brachycephalic breeds also includes the typical undershot bite, the hyperodontia (especially French bulldogs and boxers) and persistent deciduous teeth, which increase a lack of space in addition. In human medicine, it is furthermore assumed that a crowding of the teeth or a reduced space in the jaw favors the occurrence of tooth retention (2). Dental retention occurs when a tooth in the jaw remains enclosed and does not break through, although the tooth germ is at the proposed place for it. We must point out that any impacted tooth can lead to the formation of a cyst. Brachycephalic dogs have an extremely short jaw, leading to a pronounced lack of space for the teeth. With this study, we want to answer the question, if the occurrence of retention of teeth and the formation of retention cyst in brachycephalic dogs is more often than in mesocephalic dogs. Another aim of this study is an attempt to estimate the clinical relevance of tooth retention in the dogs.

Materials and methods

We present the first results of a study of 319 brachycephalic dogs. A CT scan of the head was performed with all animals. The study examined the number of teeth, the appearance of rotations, retention, retention cysts and persistent deciduous teeth, the ratio of root length to crown length of maxillary canines in relation to a partial retention of the canines, as well as the increased incidence of enlarged pulp without inflammatory signs. In addition, we described the location of the mandibular canal.
and the foramen infraorbitalis, and the bony distance of the crown to the nose or to the mandibular canal. Some parameters are examined for correlations to age, gender and breed. For comparison, computed tomographic scans of the head of mesocephalic breeds (96 animals) were used.

Results

Results show that brachycephalic breeds have compared to mesocephalic dogs a marked lack of space in the jaw. The pug, followed by the French bulldog is most affected. To compensate this apparent lack, a pronounced hypodontia is often found, especially in pugs. Rotations occur in different degrees in all brachycephalic dogs. But again the pug shows remarkably often persistent deciduous teeth and significant part retention of the maxillary canines with invasion of the nasal cavity. Most of the examined animals show an incomplete dentition, molars and premolars are often missing, especially in the lower jaw. Only 1.4% of the examined pugs show 42 teeth, followed by the French bulldog (3.1%) and the English bulldog (3.6%). In the Old English Bulldog no animal showed a complete dentition. 39% of the examined boxers showed a complete dentition. The median of existing teeth in pugs is only 36. In addition retentions occur often. In this case, the breeds with the most crowding (Pug, French bulldog) seem affected most frequently. But also the boxer shows frequently retentions in the mandible. The mandibular first premolar is affected most commonly in all breeds. Additionally, retention of mandibular incisors, retention of the canines, or even retention of maxillary premolars was observed. In 35% of all unerupted teeth might occur a so-called retention cyst (follicular cysts). The pug shows even 54% of unerupted teeth a cyst formation. Those cysts can reach an enormous scale. One patient had a pathological jaw fracture due to bone destruction, another complete relocation of the ventral meatus. The control group showed significantly fewer deviations in the normal dentition (42 teeth). Only one mesocephalic dog was diagnosed with a retention cyst (Golden Retriever).

Discussion

The most important result of our study reveals a frequent incidence of retentions. This surprising frequency shows, that similar to the descriptions in humans, the shortening of the jaw and the associated shortening of the arches lead to a lack of space and this probably leads to increased retention of teeth. Potentially, any impacted tooth can form a cyst. The epithelium of the enamel organ of the unerupted tooth can form liquid (3). The increasing pressure first destroys bone, than destroy nerve and roots of nearby teeth (4). In the lower jaw it can lead to pathological fractures and in the upper jaw it can possibly extend into nasal cavity and relocate the ventral meatus. Significant respiratory problems for the animals are the consequence. In addition, literature describes the increased risk of transformation of epithelial cells originated in retention cysts into odontogenic tumors or squamous cell carcinoma (3).

Most commonly the mandibular first premolar is supposed to be affected with retention cyst (3). Our study confirmed this. Mainly dogs between 2 months and 5 years (4) are involved. There is no gender predisposition. The incidence of retention cysts in dogs is described as rare (5). Our study show, however, that it is not a rare event and therefore a correct dental status survey is part of the correct clinical investigation of the (young) dog (especially the brachycephalic breeds). In case of missing teeth an X-ray should be performed for further clarification. But also a
computed tomography offers itself as a screening method for diagnosis of orofacial cysts in the dog (4). Advantage of CT is a complete view of the skull in all planes in a short time. This facilitates the assessment of the expansion of cysts, especially in the maxilla. Our study concludes that undetected retention, especially present in the brachycephalic dogs, is an invisible danger. The consequences for the patient may include pain, instability of the jaw and relocation of airways.

References

Achievable convergence angle and the effect of preparation design on the clinical outcome of full veneer crowns in dogs

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It is widely accepted that the convergence angle of a full veneer crown preparation should be as close to parallel as possible to attain adequate retention/resistance. The shape of the dog’s canine tooth limits the veterinary dentists ability to achieve the recommended convergence angle. However, the clinically achievable convergence angle of the canine tooth in dogs has not been evaluated. In addition, the convergence angle and other physical properties of a preparation, such as height and base diameter, have been shown to affect the retention/resistance of full veneer crowns, in vitro. This effect has not been evaluated clinically in the dog. Physical properties of 32 stone dies from full veneer crowns of canine teeth were studied to evaluate the clinically achievable convergence angle and the potential effect physical properties of the preparation had on the clinical outcome of the restoration. The clinically achievable convergence angle was much higher than the current recommendation. There was an association, albeit not statistically significant, between physical properties of a preparation (convergence angle, height, base diameter) and the clinical outcome of the restoration.

Introduction:

Convergence angle is one of four operator-controlled factors in tooth preparation that influence retention/resistance of a crown restoration. For the purposes of this manuscript, we will use the following nomenclature: Taper is the angle between one axial wall of the preparation and the long axis of the preparation (Fig 1). Convergence angle is defined as the angle between two opposing axial walls of a preparation and equals the sum of the taper of two opposing axial walls (Fig 1). Convergence angles higher than 3-14° this are said to have inadequate resistance/retention form.1,2,3,4-7 In addition, according to Weed et al8, as preparation height increases, for a given base diameter, the maximal allowable convergence angle that will maintain adequate resistance form also increases. The minimum convergence angle that provides adequate resistance form is recognized as the limiting average taper and is calculated with the formula Tlim = ½ arcsin [crown height (H)/crown diameter (D)].9 Multiple studies in humans have indicated that the recommended convergence angle is rarely obtained and clinically successful preparations exceed the recommended values.10 This study attempts to establish the clinically achievable convergence angle and evaluate what effects the preparation convergence angle, height and base diameter may have on the clinical outcome of full crown restoration of the canine tooth in dogs.

Materials and Methods:

Physical properties of preparations [convergence angle (CA), preparation base diameter (D) and preparation height (H)] were measured on 32 stone dies of maxillary and mandibular canine teeth from the collection of the University of Wisconsin’s Veterinary Dentistry and Oral Surgery Service. The H/D and the limiting average convergence angle (CAlim) were then calculated. Each die was photographed in two planes. The faciolingual (FL) plane allowed
measurement of the CA between the facial and lingual axial walls (CA-FL). The mesiodistal (MD) plane allowed measurement of the CA between the mesial and distal axial walls (CA-MD). Convergence angle was measured with a digital protractor overlaying the individual die’s digital image (Fig 2) by three blinded, independent examiners (jws, cjs, jr) for a total of three measurements per die. Finally, the CA-MD and CA-FL means were combined to determine an overall mean preparation CA (CA-O). Preparation height was measured directly from each preparation with a stainless steel ruler from the gingival preparation margin to the most coronal point of the preparation along the facial axial wall. Preparation base diameter was measured from the mesial axial wall to the distal axial wall (D-MD) at the level of the preparation margin using vernier calipers and recorded for each die. Preparation base diameter was also measured and recorded from the facial axial wall to the lingual axial wall (D-FL). The D-MD and D-FL were averaged to calculate an overall mean preparation base diameter (D-O). The limiting average convergence angle was calculated for the mesiodistal angle (CAlim-MD), the faciolingual angle (CAlim-FL), and the overall preparation (CAlim-O) according to the following formula: CAlim = arcsin (H/D). For teeth with an H/D greater than 1.0, the height is greater than or equal to the base diameter and no CAlim exists. Thus, for all dies with a H/D greater than or equal to 1.0, any CA would theoretically provide adequate resistance form. The medical records of all patients corresponding to the preparations were reviewed to determine the clinical outcome of the restoration and recorded as one of three outcomes:

1. Adhesive/Cohesive failure (retention/resistence failure): This is a failure of either the bond between the cement and the tooth or between the cement and the restoration or within the internal bond of the cement.

2. Tooth fracture failure: This is not a bond failure and is represented by a tooth crown fracture with some of the natural crown still adhered to the interior surface of the restoration.


All preparation measurements and calculations (CA, H, D, H/D, CAlim) were expressed as a mean ± SD. Data ranges were also recorded. Where appropriate, MD and FL means ± SD were averaged to calculate an overall preparation mean ± SD. Inter-examiner reliability for measurement of CA was estimated using the intraclass correlation coefficient (r). The relationship between H/D and CA was evaluated by calculating the Spearman correlation coefficient (ρ). One-way analysis of variance (ANOVA) was utilized to evaluate any associations between preparation measurements/calculations and the clinical outcome. A value of p ≤ 0.05 was considered indicative of statistical significance.

Results:

The mean ± SD for CA-MD was 35.50° ± 1.99 (range = 17.01° - 70.14°). The mean ± SD for CA-FL was 18.48° ± 1.51 (range = 7.86° - 35.6°). The mean ± SD for CA-O was 26.71° ± 1.75 (range = 12.43° - 46.70°). The degree of inter-examiner reliability for CA measurements was found to be high (r = 0.9813 for CA-MD, r = 0.9792 for
Table 1 shows the percentage of preparations distributed among three categories (<12°, 12.1°-25°, and >25°). When considering CA-MD, 0/32 (0%) were within the recommended range. When considering CA-FL, 10/32 (31.25%) were within the recommended range. When considering the entire preparation (CA-O), 0/32 (0%) were within the recommended range.

The mean ± SD for preparation height was 11.24 mm ± 3.48 (range = 6.5 - 20.5 mm). The mean ± SD for D-MD was 9.12 mm ± 1.51 (range = 6.0 - 12.0 mm). The mean ± SD for D-FL was 5.94 mm ± 0.72 (range = 4.0 - 7.0 mm). The mean ± SD for D-O was 7.53 mm ± 0.98 (range = 5.25 - 9.5 mm). In general, the D-MD was larger than D-FL and H was larger than D.

When considering CA-MD only, 0/32 (0%) were within the recommended range. When considering only H/D-FL, 23/32 (71%) were > 1.0. When H/D-O was considered, 28/32 (87.5%) were > 1.0. When considering the overall preparation, 32/32 (100%) had a CA below the corresponding CAlim.

Upon evaluation of the data, a significant association between H/D and CA was seen (MD: \( \rho = -0.76 \), FL: \( \rho = -0.62 \), O: \( \rho = -0.8 \)). As H/D increased, CA decreased and approached what has been traditionally considered ideal (Fig 4).

Restorations that failed via adhesive/cohesive failure had numerically higher mean ± SD CA's (CA-MD: 50.62° ± 1.02; CA-FL: 25.34° ± 2.54; CA-O: 37.98° ± 1.78) than those that failed via tooth fracture (CA-MD: 28.38° ± 1.13; CA-FL: 18.58° ± 0.62; CA-O: 23.46° ± 0.87) and those that did not fail (CA-MD: 34.42° ± 2.16; CA-FL: 17.46° ± 1.46; CA-O: 25.72° ± 1.81) (Table 3). However, this association was not statistically significant (CA-MD: \( p = 0.07 \), CA-FL: \( p = 0.26 \), CA-O: \( p = 0.06 \)).

Restorations that failed via tooth fracture had a higher mean H/D than those that did not fail and those that failed via adhesive/cohesive failure (Table 4). However, neither of these associations were statistically significant (H/D-MD: \( p = 0.22 \), H/D-FL: \( p = 0.26 \), H/D-O: \( p = 0.23 \)).

The number of adhesive/cohesive failures with a CA that exceeded the CAlim was numerically higher (1/3; 33.33%) than the number of both fracture failures (0/3; 0%) and non-failures (3/25; 12%) with a CA that exceeded CAlim (Fig 6). However, this
association was not statistically significant (CAlim-MD: \( p = 0.66 \), CAlim-FL: \( p = 0.9 \), CAlim-O: \( p = 0.9 \)).

Discussion:

Jorgensen\textsuperscript{11}, and others\textsuperscript{12,13}, showed that if a tensile force was applied, the amount of force required to separate a restoration would drop as the convergence angle increased. Several studies in humans have shown that such a low convergence angle can rarely be achieved clinically and fall between 12.8° to 27°.\textsuperscript{14,15,16-19} The present study reveals convergence angles between 7.86° and 70.14°.

Noonan et al\textsuperscript{18} found that the ideal convergence angle was achieved only 5.3% of the time. Patel et al\textsuperscript{19} found that only 3-13% of preparations fell within the recommended convergence angle range depending on the axial walls measured. Our study revealed an incidence of ideal convergence angles between 0% and 31.25% depending on which axial walls were measured. Considering the convergence angle that would be of most clinical interest (CA-MD) 0% were within the recommended range (<12.0°). In addition, when considering only the CA-MD, 75% of the preparations had a CA >25°.

Sato et al\textsuperscript{10} discovered that as the preparation height decreased, the clinically achieved convergence angle increased. The present study reveals a similar pattern. As the preparation height decreases, achieving a low convergence angle becomes even more important to maintain retention/resistance. However, due to the naturally steep inclination of the cervical distal axial wall of the canine tooth, achieving a lower convergence angle in this region becomes extremely difficult, if not impossible. Our study showed that restorations that failed via adhesive/cohesive failure had numerically higher mean CA’s than those that failed via tooth fracture and those that did not fail (Table 3).

The height and base diameter also influences retention/resistance form. Kaufman et al\textsuperscript{12} showed that for a given base diameter and convergence angle, an increase in height resulted in increased retention. According to Weed et al\textsuperscript{3}, for a given tooth diameter and convergence angle, preparation height is directly proportional to dislodgement resistance. Conversely, for a given height and diameter, convergence angle is inversely proportional to dislodgement resistance. The present study suggests a similar association in dogs. Those restorations that proved not to have adequate retention/resistance generally had a lower H/D (Table 4; Fig 5).

Parker et al\textsuperscript{9} developed the concept of limiting average taper (Tlim), which allowed the authors to calculate a limiting taper at which any taper above this value does not have resistance form and any taper below this value does have resistance form. In the present study those preparations with a CA that exceeded CAlim were 2.7 times more likely to suffer an adhesive/cohesive failure compared to those that did not have a CA that exceeded the CAlim. Our overall clinical failure was 6/31 (19.35%). Three (9.67%) cases were considered failures in retention/resistance form. This is comparable to a previous report of the clinical performance of metal crowns in dogs\textsuperscript{20}.

Conclusion:

The data presented here does suggest an association between physical properties of a preparation and the clinical outcome: preparations with a high CA are more likely to not have retention/resistance form; successful restorations can have a CA higher
than that which is recommended; preparations with a high H/D are more likely to have retention/resistance form but also more likely to fracture; the chance of adhesive/cohesive failure may be higher if the CA exceeds the calculated CAlim.

References: Available upon request
Tooth resorption in cats, contribution of vitamin D and inflammation

Henriëtte Booij-Vrieling, DVM, DDS, PhD

INTRODUCTION

Tooth resorption (TR) is a widespread phenomenon in cats. Up to 75% of cats are affected (1). Odontoclasts, cells that resemble osteoclasts in many ways, are the responsible cells for the resorptive process. The production and activity of osteoclasts are increased by Vitamin D and inflammation. Both high and low levels of circulating vitamin D metabolites have been mentioned to play a role in TR in cats (2, 3). Since periodontal disease is often seen in cats, with a prevalence of 70% (4, 5), feline teeth are subjected to inflammatory changes and its effects on odontoclasts (6). Cytokines produced during inflammation can stimulate or inhibit osteoclast activity, directly, or through the receptor activator of nuclear factor-kappaB (RANK)/receptor activator of nuclear factor-kappaB ligand (RANKL) pathway (7). We studied at a local level how vitamin D and inflammation contribute to the onset and progression of TR.

MATERIALS AND METHOD

mRNA levels of (inflammatory) cytokines and important genes involved in the vitamin D pathway (vitamin D receptor (nvdr), 1alpha-hydroxylase and 24-hydroxylase) were measured by quantitative PCR (Q-PCR) in feline tissue derived around TR lesions in 13 cats with TR (35 samples) and in 10 control cats (43 samples). Expression was normalized to five reference genes: hprt, rpl17, rpl30, rps19 and ywhaz. Immunohistochemistry was performed on 17 lesions with antibodies against the proteins vimentin, VDR, MSX2, and RANKL. Serum levels of the vitamin D metabolites 25(OH)D, 1,25(OH)2D, and 24,25(OH)2D from cats with (n=10) and without (n=12) TR were measured. 25(OH)D and 24,25(OH)2D were measured with a competitive protein binding assay (CPB) with rat-DBG (vitamin D-binding-globulin) as binder protein. 1,25(OH)2D extract was measured with a radioreceptor assay (RRA).

RESULTS

The relative expression of il-1β, il-6, il-10, tnf-α, ifn-γ, and nvdr mRNA were significantly higher in the TR group than in the control group (p≤0.001), with the relative expression of the pro-inflammatory and pro-resorptive cytokine il-6 mRNA being increased nearly 100-fold in the TR group relative to the control. Levels of nvdr mRNA showed a strongly significant 3-fold increase in the TR group (p=0.001), whereas levels of rankl and opg mRNA were not significantly different between the TR affected group and control group (8). Relative gene expression levels of 1alpha-hydroxylase and 24-hydroxylase were up-regulated (9).

Odontoclasts were frequently found in the resorption lacunae, often surrounded by inflammatory cells. Fibroblasts were also abundant in these areas. VDR, MSX2, and RANKL were located in the cytoplasm and the nuclei of the odontoclasts. VDR was identified in the nucleus of the fibroblasts, whereas MSX2 was identified in both the nucleus and the cytoplasm of fibroblasts. RANKL was also expressed in the fibroblasts, but to a much lower extent than VDR and MSX2. Almost all fibroblasts at sites of physiological resorption of deciduous teeth were negative for VDR. VDR was not expressed in odontoclasts at these sites. The plasma level of 1,25(OH)2D was
significantly higher in cats without tooth resorption than in cats with such lesions, whereas the plasma levels of 25-hydroxycholecalciferol (25(OH)D) and 24,25-dihydroxycholecalciferol (24,25(OH)2D) did not differ significantly between the two groups (9).

DISCUSSION

Under the influence of inflammatory cytokines (interleukin-1 (IL-1) and tumour necrosis factor (TNF-α)), macrophages and endothelial cells increase the production and activity of 1α-hydroxylase and consequently the production of 1,25(OH)2D from circulating 25(OH)D (10,11). 1,25(OH)2D exerts its function through its receptor VDR, which is further enhanced by a homologous up-regulation of the receptor (12).

In general, vitamin D can act in an endocrine or paracrine/autocrine fashion. In the case of tooth resorption:

• An endocrine role would imply that 1,25(OH)2D is generated by the hydroxylation of 25(OH)D in the kidney. Systemically circulating 1,25(OH)2D would then be responsible for an increase in odontoclast activity.

• A paracrine/autocrine role implies that the local production of 1,25(OH)2D contributes to the pathogenesis of tooth resorption in cats by increasing odontoclast activity.

We did not find elevated levels of the vitamin D metabolites 25(OH)D, 24,25(OH)2D, and 1,25(OH)2D in plasma from cats with tooth resorption (9) and assume that systemically circulating 1,25(OH)2D does not play a significant role in tooth resorption in cats. The up-regulation of 1α-hydroxylase mRNA may support the paracrine/autocrine production of 1,25(OH)2D (11). Where the skeleton may function as an intracrine organ for 1,25(OH)2D (13), the tissues surrounding the teeth may function as such in feline tooth resorption. This is supported by the up-regulation of 24-hydroxylase mRNA, a well-known target gene of the vitamin D pathway (14). We demonstrated an up regulation of the mRNA levels of inflammatory cytokines, the nvdr and 1alpha-hydroxylase and 24-hydroxylase in dental samples from cats with tooth resorption (8, 9). In line with this finding, we noted VDR protein expression in fibroblasts and odontoclasts in the resorptive stage (9). Tooth-associated fibroblasts are osteoblast-like cells and they have the capacity to induce osteoclast formation through the RANK-RANKL pathway (15). We propose that fibroblasts expressing VDR modulate odontoclast activity, and that the local vitamin D pathway is a stimulatory factor in odontoclast differentiation and activity, and thereby has a stimulatory function in the pathophysiology of tooth resorption in cats. The findings are supportive for a para/autocrine role of 1,25(OH)2D in odontoclasts in cats with TR, irrespective of dietary vitamin D level.

CONCLUSIONS

According to this model, odontoclast activity in cats with tooth resorption is stimulated by locally produced 1,25(OH)2D, which is enhanced by inflammatory cytokines. The local actions of 1,25(OH)2D are facilitated through VDR-expressing fibroblasts and may increase RANKL- and MSX2 expression by odontoclasts. Close to the site of active tooth resorption, the production of 1,25(OH)2D is up-regulated, as reflected by the local up-regulation of 1α-hydroxylase mRNA. The up-regulation of nvdr mRNA reflects the prerequisite for 1,25(OH)2D to be functionally active. The up-regulation of
24-hydroxylase mRNA further supports the increased activity of local vitamin D metabolites. The level in which endocrine vitamin D contributes to these local actions needs further research.

REFERENCES
New biodegradable membrane for periodontal tissue engineering

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ABSTRACT

The main aim of the present study was to develop a suitable scaffold material to be used in guided tissue regeneration of the periodontium. The design of this newly developed construct consists of a double layer scaffold which comprises a wet-spun fiber mesh, functionalized in-situ with silanol groups which promotes osteogenesis, and an impermeable membrane. The porosity and topography of the fiber mesh and of the membrane respectively were optimized to obtain effective cell adhesion and proliferation. The scaffold was also characterized in terms of chemical surface characteristics, degradation behaviour and mechanical properties.

INTRODUCTION

** Periodontium **, the organ which sustain the tooth is often affected by periodontal disease, an inflammatory disease which can progresses with bone resorption, cementum necrosis and gingival recession or hyperplasia and ultimately, when untreated, leads to tooth exfoliation. Tooth extraction surgery was considered the standard procedure to treat PD, meanwhile, other therapies/procedures have been used with the aim of inducing periodontal regeneration, such as: gingival flap techniques, scaling and root planning, root conditioning with demineralizing agents, direct injection of enamel matrix derivatives, growth or differentiation factors and platelet rich plasma (PRP) to the root surface, «in situ» application of filler materials like autografts, allografts and alloplastic materials (hydroxyapatite-HA and tricalcium phosphate-TCP) and ** guided tissue regeneration ** (GTR).

GTR was proposed to guide selectively the cell proliferation in different compartments, as bone or PDL, being the first technique that avoid some of the major drawbacks reports for the other approaches, namely, the gingival epithelium and connective tissue expansion, ankilosis and radicular resorption phenomenon and the difficulty to avoid the collapse of the periodontal defect. Several non-absorbable and absorbable (synthetic or natural) polymers and composite membranes have also be tested in this application.

Recently, ** Tissue Engineering ** (TE) as emerged as an alternative approach for periodontal regeneration. TE involves the use of a support material where mesenchymal stem cells from adult tissues with multipotential capacity are seeded and cultured in order to obtain hybrid materials which can temporary substitute and induce the regeneration of the target tissue.

In this work, we described the development and characterization of a new **scaffold** composed by two different layers: a starch+poly(e-caprolactone) (SPCL) membrane which is expected to degrade along the formation of cementum and periodontal ligament and act as GTR barrier for epithelium and bone tissue growth, and a fiber mesh made of SPCL functionalized with calcium and silica, two ions that have already proved to have osteoconductive properties, and which is expected to
promote the regeneration of the osseous component of periodontium. Currently we are also studying the proliferation and differentiation of adult mesenchymal stem cells obtained from adipose tissue in both surfaces, evaluating their behavior along different culture periods and conditions in order to establish the optimal conditions to obtain a suitable tissue engineered construct a future autologous approach in dogs.

MATERIALS AND METHODS

PRODUCTION OF THE SCAFFOLDS

To produce the membrane, a polymeric solution of SPCL [a 30:70 % w/w blend of starch with epsilon-poly(caprolactone)] was casted on a mold to obtain a membrane. Fiber mesh was obtained by wet-spinning technique injecting the same solution through a needle into a coagulation bath of calcium silicate. Then, the two components were attached to obtain a single scaffold.

SCAFFOLDS CHARACTERIZATION

The morphology of all the developed materials was analyzed by scanning electron microscopy (SEM). Fourier Transmission Infra-red (FTIR) analysis was performed to assess the surface chemical composition of fiber mesh part. Tensile strength of the double layer scaffold was measured. Degradation behavior under effect of enzymes present in the dog serum (alpha-amylase and lipase) was evaluated, namely, the weight loss, water uptake, scaffold morphological changes and calcium and silica elemental release to the solution.

RESULTS

MORPHOLOGICAL CHARACTERIZATION

Scanning electron microscopy revealed roughness in the surface of the membrane obtained using the mold. The microscopic image of the SPCL-CaSi fiber mesh showed us a rough surface with fibers around 195 µm and interconnected.

SURFACE CHEMICAL COMPOSITION CHARACTERIZATION

FTIR analysis of wet-spun fiber mesh with silanol functionalization showed siloxane bonds (Si-O-Si), Si-O and Si-OH.

TENSILE TESTS

Regarding the wet samples, they have less mechanical properties against traction stress comparing to the samples in dry state. However, the last ones demonstrate a significant increase in the elongation capacity.

DEGRADATION BEHAVIOUR

After only one day of enzymatic action the material showed a water uptake (WU) around 60 %. Then, there was a continuous increase of WU, particularly, in the samples immersed in lipase and α-amylase+lipase.
The loss of weight was gradual in all enzymatic conditions. Lipase was the enzyme with higher effect under the material. SEM analysis of the surface of the membranes after enzymatic degradation resulted in modification of the surface topography, diameter of the fibers and roughness increasing. We observed a higher calcium release from the samples in lipase. Instead of that, the silicium was much more released to solution in samples in PBS and amylase.

DISCUSSION

Regarding surface topography, both aspects of the developed membrane are suitable to cell adhesion and proliferation due to its roughness, porosity and interconnectivity of the fibers. Mechanical properties of this scaffolds, particularly, the resistance against traction forces, are enough to maintain its architectural integrity in the periodontal defect and be able to be sutured to the surround tissue. It was proved that this membrane is suitable to be degraded by two serum enzymes. The functionalization of the fiber mesh with osteoinductive groups was verified, conferring to this membrane the potential to act positively in the regeneration of osseous component of periodontium, avoiding the use of other strategies, namely, the use of filling materials.

At the present moment, biological tests with adipose adult stem cells is being performed, evaluating the potential to proliferate under the material surface and differentiate to different cellular lineages, in order to provide to this scaffold the possibility to be used in a tissue engineering strategy of periodontal ligament and alveolar bone regeneration.

CONCLUSIONS

Investigation in periodontal tissue engineering is a demanding area of veterinary and human dentistry professionals and the development of new approaches which able the clinical practitioner to reach the maximum efficacy in the regeneration of periodontal damages is mandatory. Contribution of different fields of medical, biological and chemical sciences is vital to better understand the mechanisms of the disease and the therapeutic strategies which can be applied.

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REFERENCES

Local and Regional Anesthesia in Oral Surgery

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

Introduction

Local and regional anesthesia is commonly performed in cats and dogs with oral disease. It is an effective measure in saving medical expenses, as it has been reported to reduce the concentration of an inhalant anesthetic needed, which also would minimize complications from hypotension, bradycardia and hypoventilation. Consequently, such patients should recover more quickly and with fewer complications. Local and regional anesthesia also provides analgesia in the postoperative period, thus increasing the patient's comfort and decreasing the need for systemic analgesics.

Terminology

Local anesthesia is also called infiltration anesthesia and refers to the injection/application of a local anesthetic solution into/onto tissues at a surgical site, for example along planned incisions. Topical anesthetic gels may provide temporary relief from superficial pain; their effects are short-lived, and thus topical anesthetic gels are infrequently used in oral surgery. Splash block is also called wound irrigation and refers to the dropping of a local anesthetic solution directly onto an incision or wound, for example into the nasal cavity after a maxillectomy prior to closure of the surgical site. Regional anesthesia (nerve block) refers to injection of a local anesthetic solution around a major nerve utilizing 27-gauge, 1½ inch needles on 1 ml syringes (22-gauge needles when going through skin). This procedure is most commonly performed in dentistry and oral surgery for the maxillary nerve, infraorbital nerve, major palatine nerve, inferior alveolar nerve (mandibular nerve), and the middle mental nerve.

Local Anesthetics

Commonly used local anesthetics include bupivacaine 0.5% (effective for 6 to 10 hours), mepivacaine 2% (effective for about 4 hours) and lidocaine 2% without epinephrine (effective for less than 2 hours). The onset time for analgesia is longer with longer acting local anesthetics (few minutes for lidocaine, up to 30 minutes for bupivacaine). The total maximum dosage for bupivacaine in cats and dogs is 2 mg/kg and for lidocaine in the dog 5 mg/kg and in the cat 1 mg/kg. There are 5 mg of bupivacaine in 1 ml of a 0.5% solution (bupivacaine 0.5%).

Specific Nerve Blocks

The maxillary nerve block is given just caudal to the last molar tooth where the maxillary nerve enters the infraorbital canal through the maxillary foramen. An extraoral technique can also be utilized. Care must be taken not to inject anesthetic into the eye globe. The areas blocked include the incisive bone, maxilla and palatine bone, all maxillary teeth on that side and adjacent soft tissues.

The infraorbital nerve block is given at the infraorbital foramen or inside the infraorbital canal. The areas blocked include the incisive bone and maxilla, maxillary
incisors, canine, and premolars/molars (depending how far the needle is advanced into the infraorbital canal) and adjacent soft tissues.

The major palatine nerve block is given through the thick palatal mucosa just rostral to the major palatine foramen (palatal to the maxillary fourth premolar about halfway towards the midline). The areas blocked include the palatine shelf of the maxilla and adjacent soft tissues.

The inferior alveolar (mandibular) nerve block can be given intraorally (at a relatively flat angle through the alveolar mucosa at the lingual surface of the mandible) or extraorally (through the skin at an unnamed notch at the ventrolingual surface of the mandible). The areas blocked include the mandibular body, all mandibular teeth and adjacent soft tissues.

The middle mental nerve block is given at the middle mental foramen ventral to the mesial root of the second premolar (dog) or halfway in between the canine and third premolar (cat). The areas blocked include the rostral mandibular body, teeth rostral to the injection site and adjacent soft tissues.

References
The use of neurolept anesthesia and MLK for greater safety for dental patients

Paul Theuns, DVM

Introduction

General Anaesthesia, is mandatory to perform good veterinary dentistry. In the older and ASA grade 3, 4 patients, the risks are higher than in young healthy animals. In order to give them a safe anaesthesia we need to adapt our methods.

Whereas in young and healthy animals premedication and induction with an intramuscular injection is acceptable, this author preferably uses intravenous anaesthesia for the old and compromised animals. This author would also recommend veterinarians to start using intravenous anaesthetic induction on all their dental patients.

Examples

Although there are numerous ways to induce anaesthesia this author will only give some examples of premedication and induction before intubation and inhalation anaesthesia that this author has very good experience with.

Four types of anaesthetic premedication will be discussed. Under most of the circumstances they are used as

These four all have their own benefits and advantages and disadvantages. They will be discussed in detail during the lecture.

The four types are;

Premedication

For the premedication this author prefers opioids. Opioids are drugs that work in a similar manner to morphine. They exert their effects by binding to opioid receptors. These receptors are found not only in the brain but also in the periphery, especially after inflammation. In cats they can cause increased locomotor activity and excitement (in large doses). This is thought to because cats have fewer mu receptors in their CNS than other species and so require lower doses, an other side effect in the cat is mydriasis. Because of this side effect the cats eyes are irritated towards bright light, this author noticed that this further increases the excitement and locomotor activity.

In the dog there are more mu receptors in the CNS, the opioids have a stronger sedative effect and the side effect is miosis.1

Another side effect of the opioids is respiratory depression, because opioids reduce the sensitivity of the respiratory centre to changes in blood carbon dioxide tension.

Gastrointestinal effects

Many opioids act on the chemoreceptor trigger zone (CTZ) to initiate vomiting. However the more fat-soluble they are the faster they cross the blood-brain barrier where they inhibit the vomiting centre to prevent vomiting.1

This author uses 3 opioids on a regular base;

1. Butorphanol (IV)

Is a mu receptor agonist antagonist with affinity for both mu and kappa receptors. It has mainly antagonist activities on the mu receptors. The duration of activity can vary from 45 minutes till up to 5 hours depending on species dose and circumstance.

Disadvantage: low analgesia.
Advantage: fast onset (5 minutes after IV) and strong sedative effect.
Dose:
Dogs 0.1-0.5 mg/kg IV/IM
Cats 0.1-0.5 mg/kg IV/IM

2 Buprenorphine (IV)
Has a very high affinity for mu receptors but only a partial agonist activity at these receptors.
Advantage: long duration of activity (6-8 hours)
Can be used in cats for oral transmucal administration (OTM)
Disadvantage: slow onset time (30 minutes)
Dose:
Dogs 0.01-0.04 mg/kg IV/IM/SC
Cats 0.01-0.04 mg/kg IV/IM/SC

3 Methadone (IM)
Is a pure mu agonist, very similar to morphine except it doesn’t tend to initiate vomiting (this is an advantage), because of its greater lipid solubility than morphine. This also means that it has a quicker onset time (5 minutes, IV) than morphine (20 minutes)
Advantage: very good analgesia
Disadvantage: long lasting sedation
Dose:
Dogs 0.1-0.4 mg SC/IM/IV
Cats 0.1-0.5 mg SC/IM/IV

Neuroleptanalgesia:
This author combines one of the above-mentioned opioids with Benzodiazepines, their main advantage is that they cause minimal respiratory and cardiovascular depression at recommended dose, they reduce the required dose of propofol

Diazepam (IV)
Dose:
Dogs and cats 0.1-0.2 mg/kg IV
Advantage:
Muscle relaxant, hypnotic, anxiolytic
Is more reliable (IV) than midazolam with regards to its effect.
Disadvantage
Not well absorbed after IM administration (use midazolam), so its bioavailability is poor
Slower onset of action than midazolam
Produces drowsiness lasting 4-12 hours (1-4 hours for midazolam)

Midazolam (IM)
Dose:
Dogs and Cats 0.1-0.3 mg/kg IM!
Advantage:
Can be injected IM because of its water solubility
Disadvantage:
Specially in the cat a less predictable effect
Induction
propofol or etomidate

propofol:
comes in 2 forms,
1 a milky emulsion of soybean oil glycerol and egg phosphatide
disadvantage:
must be used within 6 hours after opening
2 a lipid-free (aqueous) nano–droplet micro emulsion
advantage:
can be used for 30 days after opening
Propofol is extremely rapid metabolized in the liver and also at extrahepatic sites and
because it is completely metabolized there is no hangover effect, except when
repeated doses are given to the cat, in the cat this has a cumulative effect
Mild to moderate respiratory depression can occur and if post induction apnoea
happens, it can last for several minutes, in this light it is recommended to
preoxygenate for a few minutes before administration of propofol.

Dose
On effect, it has to be administered slowly in order to make it possible if the desired
effect is reached

Etomidate
Induction agent of choice in case of patients with cardiovascular problems, but not
recommended for this purpose in cats.

Dose
Dogs: 1-3 mg/kg (IV)

MLK
Morphine-lidocaine-ketamine infusions, morphine can be replaced by methadone
(Muir 2009)
Although in the original article by dr Muir only induction with propofol is mentioned,
this author recommends the use of a neuroleptanalgesia as a premedication in
order to diminish the respiratory depression caused by propofol
Advantage: can provide an excellent analgesia and the infusion can be continued
post operatively at a slower rate
All three components are added to one infusion line.

Dose
To the same syringe ad;

150 mg (7.5mL) of 2% lidocaine hydrochloride
10 mg (0.8 mL) of morphine sulfate (or methadone)
30 mg (0.3 mL) of ketamine hydrochloride
inject the final volume (8.6 mL) into a 500-mL bag of lactated
Ringer’s solution.

the infusion rate is 10 ml/kg/hour

3 Veterinary Anesthesia Drug Quick reference, Blaze Glowaski, Elsevier-Saunders, 2004 pgs. 17-74
4 Effects of morphine, lidocaine, ketamine, and morphine-lidocaine-ketamine drug combination on minimum alveolar concentration in dogs anesthetized with isoflurane. 2003

Muir WW 3rd, Wiese AJ, March PA.
Disease and Halitosis

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Halitosis (bad breath) is a common complaint by pet owners. It may constitute a significant psycho-sociological problem affecting the human-pet relationship and it may be a sign of serious, underlying disease. Halitosis may have an oral or non-oral etiology. Malodors of non-oral origin may be related to gastro-intestinal disorders, respiratory infections or systemic disease (1). Malodors originating from the oral cavity may arise from microbial metabolism on the tongue and periodontium, and from saliva and food stagnation (2, 3). The predominant source of bad breath is the oral cavity. In humans, oral hygiene procedures such as tooth brushing, professional periodontal cleaning and tongue scraping all markedly reduce oral malodor. Conditions such as periodontitis and caries increase the incidence and intensity of odor (4).

Oral malodor is produced as a result of microbial metabolism of exogenous and endogenous proteinaceous substrates. These substrates can be derived from food debris, exfoliated oral epithelium, saliva, blood and gingival crevicular fluid. The proteins derived from these sources are broken down into peptides and amino acids, which are further metabolized to highly volatile compounds. It is these volatile compounds that are perceived as oral malodor (5). Periodontal disease is strongly implicated in the production of oral malodor. Increased plaque accumulation, gingivitis and increased periodontal probing depth (periodontitis) correlate with an increased production of volatile sulfur compounds and incidence of malodor (6-9). Reduction of microbial load in the oral cavity due to good oral hygiene practices (such as tooth brushing) or by the use of appropriate diets or chews have been shown to reduce malodor formation (10-12).

While the most common source of halitosis is the oral cavity, a patient presented with a malodor complaint requires a full general examination to exclude non-oral causation of the problem as well as a meticulous oral examination under general anesthesia.

References available on request (cecilia@doctoothfairy.com)
How can I manage Examination (Diagnosis)

Serafim A. Papadimitriou DVM, DDS, PhD, Assistant professor

Halitosis, or oral malodor, or bad breath in dogs and cats is a significant and annoying problem for their owners. Consumer research has confirmed halitosis as a leading concern among owners (1). Canine oral malodor may be the first indication that a serious disease process is occurring in the oral cavity. Malodor usually is caused by oral tissue destruction (primary or secondary infections) (2). Oral tissue destruction may be caused due to various oral conditions; the most common among them is periodontal disease; as many as 80% of dogs aged 2 years and older are affected and almost all dogs older than 5 years are suffering from periodontal disease (3). Increasing periodontal pocket depth is correlated with an increased production of hydrogen sulfides and incidence of oral malodor (4). Other oral conditions like oral tumors, periapical tooth abscess or fistulas, cat gingivostomatitis, stagnation of food, saliva and oral debris, such as epithelial cells, and reduction of salivary flow, or the presence of a foreign body can also cause oral malodor (2).

The primary source of oral malodor arises from the production of volatile sulfur compounds (VSC) such as hydrogen sulfide and methyl mercaptane. VSC production is associated with the microbial load of the mouth and mostly the gram negative anaerobic bacteria (5, 6).

Diagnosis of oral malodor is based on history, general physical examination, initial oral survey, preanaesthetic diagnostic tests, in depth oral examination, oral diagnostic testing, periodontal probing, oral and dental charting, diagnostic imaging and biopsy if necessary. General anaesthesia is indispensable for thorough oral examination(7).

Various specific methods can be used for the detection of oral malodor. The two most common methods are the use of portable monitor (i.e. halimeter) that measures VSC and sensory evaluation (8). Recently a chemical sensor system called an “electronic nose” has given promising results in humans (9). Hennet et al (1998) suggested that VSC production is correlating with the amount of plaque and calculus on teeth surfaces in dogs suffering from gingivitis or periodontitis.

In humans, it has been suggested that changes in structure or diversity of oral microflora can participate in the pathogenesis of several oral diseases or might be induced by pathological conditions such as squamous cell carcinoma. This might be explained by changes in present adhesive molecules and bacterial tropism (10, 11). Cultivation of anaerobic bacteria is quite difficult, DNA extraction techniques may lead to an easier method for detection of oral microflora changes and primary diagnosis of oral disease (10, 12).

References


Halitosis Treatment: Medical and Surgical Management

Peter P. Emily, DDS, Hon. AVDC

INTRODUCTION
Halitosis in dogs and cats has one of four root causes: Periodontal, pulmonary, or turbinate/sinus disease, or gastro/intestinal disturbance.

Periodontal disease is by far the primary cause. Contamination of microorganisms and irritation from plaque, food debris and necrotic waste ruminants are the primary factors.

DISCUSSION
Contingent upon initial clinical evolution and treatment plan, initial therapy with pocket depth measurements, bleeding, calculus and plaque indexes are recorded, followed by thorough prophylaxis. Home care with tooth brushing instructions and the use of proper toothpaste, such as CET, water additives such as Aquadent, and an Oral Hygiene Rinse, accelerate initial therapy. Re-evaluation of the periodontium is done 1 to 2 weeks post-initial therapy and home care. Initial therapy and good home care often changes the initial treatment plan. If surgical intervention is indicated the benefits of initial therapy outline the degree of surgical involvement.

Stages 1, 2 and 3 of periodontal disease can usually be treated with prophylaxis, open and/or closed curettage and home care.

Stages 4 and the beginning of stage 5 periodontal disease require periodontal surgical intervention, such as mucogingival surgery, gingivoplasty, and bone augmentation.

CONCLUSIONS
Post operative care is essential. Home care regimen must be maintained to prevent periodontal disease exacerbation.
Halitosis and Periodontal Disease: a Practice Management Perspective

Philippe Baralon

Abstract not submitted at the time of printing of the Proceedings, will be inserted as separate page
Histological observation of mandibular salivary gland 3 and 6 months after ligation of the duct, preliminary work

Ayako Okuda, Keiko Shimoda, Yoshihiro Nakagaki, Nobutune Ichihara, Masao Asari

Histological observation of salivary gland was performed 3 and 6 months after the duct ligation in a clinical case of a dog. There were no significant morphological changes in the glands after ligations. Staining behaviors of HE, ALB-PAS, CA-II and CA-VI in glandular cells, epithelium of duct and interstitial tissues were as normal tissues and cells.

In cases of tumor removal ligations of salivary duct is useful method for control excess salivation, secondary dermatitis and secondary mucocele. General concerning that physical obstruction, ligation, may result secreting problem, such as mucocele, cyst, sialolitis and/or salivary stone formation. However, no mucocele, cyst or stone formation were not observed in dogs with experimental ligation of salivary duct (1), functional degeneration of salivary secretion or synthesis were observed in rat with parotid ligation(2). There is a few reports to observe the effect of salivary duct ligation on the gland. Histological observation of salivary gland was performed 3 and 6 months after the duct ligation in a clinical case of a dog.

Material and Methods
Mandibular duct ligation was performed on a 7-year-old spayed Golden Retriever with cheiloplasty for excess salivation and dermatitis. The dog did not show any clinical signs, swelling or mucocele or cystic formation during ligation. Under general anesthesia each mandibular gland was removed 3 and 6 months after ligation. They were fixed with 10% buffered formalin and embedded into paraffin. They were sectioned and stained by HE and PAS-Alcian blue stainings for observing morphological changes and distribution of mucopolysaccharides in the glands. Also carbonic anhydrase II and VI was also stained immunohistologically for detecting secretive disorder.

Results
There were no significant morphological changes in the glands 3 and 6 months (6mo) after ligations. Staining behaviors of HE, ALB-PAS, CA-II and CA-VI in glandular cells, epithelium of duct and interstitial tissues were as normal tissues and cells.

Discussion: Degeneration of whole gland and PAS-positive cells and hyperplasia of epithelium of inner wall of duct were observed in mouse and rat 5-6 days after ligation (2). To compare of this result, any changes of cells and tissues in mandibular gland was not found in the dog without secretion problem secondary to physical occlusion of salivary duct.

References:
EVDC Interactive Session: Open Discussion of Controversial Issues I and II

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

Evidence-Based Medicine

The goal of evidence-based medicine (EBM) is to use evidence gained from research for clinical decision making. There is a wide range of evidence quality. Double-blind, placebo-controlled clinical trials certainly provide more evidence than empirical knowledge obtained from case reports.

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

Possible Topics for Discussion

- Should a plaque-preventing barrier sealant be placed onto teeth and gums after professional dental cleaning and closed periodontal pocket treatment?
- Can you do a crown-lengthening procedure with apically positioned flaps on a mandibular canine tooth without extraction of the adjacent third incisor?
- Does placing a bone graft or bone graft substitute in the absence of a membrane count as guided tissue regeneration procedure?
- Do we need to shape, disinfect and obturate the pulp chamber of multi-rooted teeth (or canine teeth with intact crown) undergoing root canal therapy?
- After how many days is vital pulp therapy no longer a treatment option for a tooth with complicated fracture (with pulp exposure)?
- What is the current standard of treatment for luxated and avulsed teeth (timing, procedures, intracanal medications, systemic medications)?
- What should the shape and dimension of a restorative cavity be at endodontic access/fracture sites and crown-root defects when considering final composite restoration?
- Should the cusp of the mesiopalatal root of the maxillary fourth premolar tooth be included in a jacket crown preparation procedure?
- What is the purpose of doing a telescoping inclined plane in an immature dog with mandibular canine teeth in linguoversion (‘base narrow’)?
- Do root remnants always have to be extracted and do tooth extraction sites always have to be sutured closed?
- Do you always have to place the interdental wire loops on the buccal surfaces of maxillary teeth and lingual surfaces of mandibular teeth when treating jaw fractures?
- What are the appropriate margins of resection for benign noninvasive tumors, benign invasive tumors, and malignant tumors in cats and dogs?
Bonded Sealants for Fractured Teeth

Brook A Niemiec DVM Dip AVDC Fellow AVD

Uncomplicated crown fractures are a very common problem in large breed dogs. These are likely to become infected. Treatment with bonded sealants will resolve the pain as well as likely avoid infection. It is inexpensive to equip the operatory for this and they are easy to learn.

Tooth Anatomy

Teeth are roughly broken up into three layers: enamel, dentin, and pulp. The innermost layer is the endodontic system (root canal or pulp). It contains the nerves, blood vessels, and connective tissue which supply and nourish the tooth during life. The blood and nervous supply enters the tooth through the very bottom or apex of the root. The outer layer of the tooth crown is enamel, which is an inorganic substance. It is virtually all (97%) calcium and phosphorus and is the hardest substance in the body. Enamel has no nervous or circulatory system. It is applied in a very thin layer (less than 1 mm thick in veterinary patients) over the tooth surface during development by a cell layer called ameloblasts. Once eruption has occurred, enamel cannot be replaced or repaired. The central layer, which is the vast majority of the tooth structure in mature patients, is dentin. Dentin has roughly the same mineral content as bone. Dentin is a somewhat living structure which has a nervous supply and can occur can respond to stresses. Running at right angels to the root canal all the way around the tooth from the root canal out to the enamel are dentinal tubules. Each one of these dentinal tubules contains an odontoblastic process, which is basically a nervous supply; however, they are only sensory and can only report changes as pain. There are approximately 50,000 dentinal tubules per mm2 coronal dentin. Therefore, a 1 cm area of enamel loss will expose 3-4 million odontoblasts!

Response to Damage

Exposure of the dentinal tubules will lead to much quicker dentinal fluid flow out through these dentinal tubules via the capillary effect. This increase in fluid flow deforms the A-delta C-delta fibers and thus will be perceived by the patient as pain. Anything that will change the flow rate will cause the nerves to fire and result in pain (sensitivity). This includes heat, cold, and desiccation. The sensitivity is actually a sign of low grade pulp inflammation known as pulpitis. These fractures are exceedingly common in large breed dogs. However, they rarely show clinical signs and therefore are only diagnosed with a careful oral exam, often under general anesthesia. Therefore, this commonly goes undiagnosed and therefore untreated. In addition to the sensitivity produced by the exposure of the dentinal tubules, there is a possibility of ingress of bacteria into the root canal system. In some cases this can result in endodontic infection and subsequent abscessation. This occasionally can be seen clinically as a swelling or draining tract, but is generally subclinical and therefore undiagnosed. The only way to diagnose this infection is via dental radiographs. Once exposure has occurred, material will accumulate on the surface which can mineralize and block the tubules (Smear Layer). In addition, the tooth will sense the
disruption of its normal protection and will attempt to shield itself from the harmful invaders of the oral environment as well as decrease the patient’s pain. This will take the form of creating either tertiary or sclerotic dentin. Eventually (as long as the causative problem is not allowed to progress), this may result in the end of sensitivity. However, this process is lengthy (likely months) and the patient is painful and susceptible to infection during this time. In addition, this may be thwarted in many animal patients due to continued attrition due to the abnormal chewing behavior that initiated the problem.

Uncomplicated Crown Fractures

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

Diagnosis

First, perform a thorough visual exam to determine pulp exposure or other extensive damage. Next, use a dental explorer or small endodontic file to definitively rule out pulp exposure (any soft spot should be a suspect). Finally, expose a dental radiograph to rule out endodontic disease.

Treatment

If the dental radiographs are within normal limits, perform a bonded sealant (see below) and recheck radiographs in 9-12 months to ensure continued vitality. If there is radiographic evidence of endodontic disease root canal therapy or extraction is indicated.

Bonded Sealant

Step one: Tooth Preparation

First, scale and polish the surface of the tooth to be treated. Make sure to use fluoride free pumice for polishing to avoid interfering with future acid etching. Next, remove any unsupported or damaged enamel with a fine diamond bur or white stone. Finally smooth the area to be bonded with either progressively fine sanding discs mounted on a Mandrel powered by a slow speed handpiece or a fine diamond bur.

Step two: acid etching

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

There are many options for bonding agents that fall into two main types:
  One step which combine the primer and bonding agent in 1 bottle
  Two Step which have separate primer and bonding agents
Ones that combine the etch are NOT strong enough!
The bonding agent should be applied in a very thin layer. After it is applied, it is light
cured with an intense blue light in the visible range for 10 seconds. Very important to
view the light through an orange filter.
If the one step bonding agent was used, it is recommended that a layer of unfilled
resin be applied to the bonding agent. This will add strength and smoothness to the
restoration. This is placed over the one step and light cured for 10 seconds.

Follow up

The patient can eat and drink normally following the restoration. Recheck dental
radiographs are strongly recommended in 6-9 months to ensure continued vitality. If
the client declines this, radiographs should be performed at the time of the next
prophylaxis.
Shortness of breath due to huge retention cysts in a pug

S. Hintze, G.U. Oechtering Prof., Dr. med.vet, Dipl. ECVAA

Chiva, a 2-year-old female pug, was presented with increasing breathlessness. As a young dog, she showed good breathing, for several months now the breath through the nose becomes more and more difficult. At this point, the suspicion was a brachycephalic airway syndrome. Chiva was referred to the Department for Small Animal Medicine of the University of Leipzig for diagnostics and surgery of the brachycephalic airway syndrom.

Before the ENT-surgery, we generally perform a computed tomography of the head and the upper respiratory tract. Subsequently we perform an endoscopy of the respiratory system.

The computed tomography showed a complete obstruction of the ventral meatus. The maxillary third premolar was embedded on both sides. The enamel organ epithelium has led to the formation of two giant cysts. The cysts have gradually destroyed parts of the maxillary bone and the palate; finally they relocated the whole ventral meatus.

Both teeth were removed and curettage of the cyst membrane was done as much as possible. Afterwards the ventral meatus was retransferred. Due to the pressure of the cysts on the turbinates, those atrophied. Today Chiva can breathe better than most dogs of her breed.

References

Management of non-resectable oral/pharyngeal Squamous Cell Carcinoma in 2 Dogs

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INTRODUCTION

Oral SCC accounts for 20-30% of oral tumors in dogs (1). It is a locally aggressive neoplasm and may arise from the lips, gingiva, tongue and oropharynx (1). At the time of diagnosis 77% have radiographic evidence of bone involvement (1). Regional lymph node (RLN) and pulmonary metastasis are rare but are more commonly present in patients with caudal tongue and tonsillar SCC (2). Clinical signs may include dysphagia, halitosis, loose/missing teeth, difficulty in food intake and mastication (1,2). Thorough diagnostic work-up and staging based on the size of the primary tumor, RLN involvement and distant metastasis is crucial for further treatment plan (2). Reported treatment options include surgery, radiotherapy and chemotherapy or a combination of these modalities (1,2). Like in human medicine progress has been made in the treatment of head and neck cancers using modified radiotherapy protocols in a combination with chemotherapy and/or target therapy drugs which showed to improve response rates and survivals.

CASE 1

A 12 year old spayed female, mixed breed dog, weighing 10.5 kg was presented for oral examination due to a 4 month history of dysphagia, severe halitosis and excessive salivation. Diagnostic work-up (including physical exam, hematology, serum biochemistry, thoracic radiography) did not detect any indications of other serious or systemic abnormalities. Conscious oral examination dog revealed the presence of periodontal disease. A thorough oral examination was performed under general anaesthesia revealed advanced periodontal disease of right maxillary premolar and molar region near a 5 cm diameter ulcerated, bleeding oral mass located adjacent to the fourth premolar and first molar teeth (108, 109). Deep periodontal pockets affecting these teeth with significant bone involvement was evident on intraoral radiography. Supra and subgingival scaling were performed, avoiding excessive interference with the mass, and the teeth polished prior to extraction of the compromised fourth premolar and first molar teeth. Computed tomography (CT) was performed. This demonstrated extensive local maxillary bone loss. Incisional biopsy of the mass was performed and histopathology identified the tumour as squamous cell carcinoma.

CASE 2:

An 8 year old male, mixed breed dog weighing 38 kg was presented for oral examination following a 3 month history of excessive salivation and loss of appetite in last 2 weeks. Diagnostic work-up (including physical exam, hematology, serum biochemistry, thoracic radiography, abdominal ultrasound) did not show any other systemic abnormalities. Oral examination under general anaesthesia revealed mass originating from the right tonsill. The retropharyngeal lymph nodes were palpably enlarged. Incisional biopsy were performed of the mass along with fine
needle aspiration (FNA) of the lymph nodes. The pathology report confirmed tonsillar squamous cell carcinoma with regional lymph node spread.

TREATMENT:

Wide surgical excision was not considered as options in either case due to the locally advanced disease and the location of the tumours. A multimodality treatment approach, consisting of radiotherapy, chemotherapy and target therapy, was suggested to the owners for both cases.

A 9 day accelerated radiation therapy protocol with concomitant carboplatin was used. Fourteen fractions of 3.5 Gy were administered over 9 days, with treatments being given twice per day, with at least 6 hours between treatments. Carboplatin (300 mg/m²) was administered on days 1, 3, 5 and 7.

Chemotherapy with carboplatine (300 mg/m²) every 3 weeks with tyrosine kinase inhibitor masitinib (Masivet) at dose 12.5 mg/kg/day were added to tonsillar SCC case. Financial restrictions precluded ongoing therapy in the maxillary carcinoma case.

OUTCOME:

Acute radiotherapy reactions for both dogs can be scored as grade 1 for the skin and grade 2 for the oral mucosa in the radiation fields. No toxicities ascribed to carboplatin were detected. No major dysphagia was detected in both dogs. Complete response was achieved 3-4 weeks after completion of the radiotherapy in maxillary case, while very good partial response was achieved in tonsillar case. At the time of writing the disease free interval for the maxillary case is 3.5 months and stable disease for the tonsillar case it is 1 month.

DISCUSSION:

Surgery is the treatment of choice for canine SCC tumors of the jaws, the prognosis being good when tumors are diagnosed at an early stage (i.e. whilst still small, without evidence of spread, and in a location that permits excision with clean margins (3). Unfortunately, as in the two cases presented here, many tumours are not detected at this stage so surgery is difficult or not possible (3,4). For this reason new and innovative approaches for the management of these types of cancer are under investigation as traditional veterinary radiotherapy protocols are considered generally ineffective in the management of oral SCC (4). These types of cancers have rapid tumour doubling time of only few days, so the dose of radiation needs to be delivered at short intervals (4,5). The use of accelerated radiation therapy protocol with radiosensitisers, as developed by Fidel and co-workers, have already been confirmed to improve the response rates for oral SCC in cats (4) and so are also expected to be of benefit in dogs affected by tumours with similar rates of growth. So far, this appears to be true for the two cases presented here, both having shown a good response within a month of completing their radiotherapy.

Use of chemotherapy agents such as carboplatin during radiotherapy has been shown to improve survival with both resectable and nonresectable advanced disease (1,2). This is presumed to be due to their radiosensitising effects on the tumour, improving the response to radiation whilst adding the drug's own anti-tumour effects. Altered fractionation combined with administration of radiosensitisers results in good locoregional control, organ preservation and minimised the severity of acute
treatment related toxicities, particularly mucositis (4,5) as seen in the two presented cases. Continuing chemo and target therapy after initial remission can help control residual local tumour cells or distant micrometastases, being more beneficial for microscopic disease than for gross tumours.

CONCLUSION

Accelerated protocol radiation therapy with use of carboplatin as a radiosensitiser appears to offer a good option for the management of non-resectable oral and oropharyngeal squamous cell carcinoma in dogs. The goals of the treatment include maximising tumour control while maintaining function and quality of life with the added advantages of the accelerated radiotherapy protocol being a short treatment time, limited toxicity and rapid tumour control. If these results are matched in future cases, it is likely that accelerated protocols will become the cornerstone therapy for advanced SCC in dogs and cats.

REFERENCES:

Epidemiological comparative study of the oral and dental pathology in the Mirandês and Zamorano-Leonês Donkeys, two endangered breeds

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INTRODUCTION

In the Northeast of Portugal and in the Zamora Province in Spain, two very close regions in geographic terms, two different native breeds of donkeys are still working and co-existing with the local population: The Mirandês Donkey, in the Portuguese side of the border and the Zamorano-Leonês Donkey, from Spain.

These animals were always present in daily life of local people, playing a critically important role in the agriculture, transportation and mule’s production. However, the two breeds are nowadays threatened of extinction, with only a few hundreds of them still breeding, as a result of the disappearing of the traditional rural activities and the aging of the local population remaining in these very rural regions1.

The low number of animal’s still resisting results in a high level of inbreeding between them, the loss of genetic variability and the appearance of pathological situations2, some of them teeth related. Developmental abnormalities (occlusal problems, oligodontia, poliodontia), abnormalities of eruption (like high incidence of retained caps) are just some examples of that.

The current situation is very similar in both breeds, with a number of animals able to reproduce no higher than 800 (about 750 females and 50 jack), but only around 160 foals per year, according to the studbooks official records.

Donkeys are very stoic animals, with a high number of animals suffering from undiagnosed dental and oral diseases, with a lot of them not showing any clinical sign of it3. A similar situation can also be observed in horses, although these are less stoic4, 5.

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 very interesting results found until the moment.

METHODS

During this epidemiological comparative research, a complete clinical, oral and dental exam is being carried out (almost exclusively in field conditions), covering between 350 and 400 working animals of each one of the breeds studied, which represents approximately 50% of the total number of animals registered in the correspondent studbook.

The animals are divided in seven different age groups: Less than 2,5; 2,5 to 5; 6 to 10; 11 to 15; 16 to 20; 21 to 25; more than 25 years old.
With all the information and data obtained during the dental and oral exam we intend to:
- Understand the normal ageing process for these two specific breeds of donkeys.
- Determine the prevalence of the dental disorders in each one of the seven age groups described below.
- Determine the prevalence of wolf teeth in both genders.
- Determine the prevalence of canine teeth in both genders.
- Correlate the prevalence of the dental disorders between the seven age groups.
- Determine the most common location of the different dental disorders (quadrants, Triadan position, etc.)
- Correlate the body condition score (BCS) and the age groups.
- Correlate the BCS and the prevalence of dental disorders.
- Correlate diet related conditions and BCS.
- Correlate the different dental disorders between them.

RESULTS

Until a recent past, the oral and dental pathology results for these endangered breeds were based only on unpublished data (data from author) obtained during the daily clinical veterinary work, in the Veterinary Departments of the two NGO responsible for the management of the studbook: The AEPGA in Portugal with the Mirandês Donkey and ASZAL in Spain with the Zamorano-Leonés, between August 2006 and March 2009. But there were no statistical results concerning to these breeds objectively reflecting the prevalence of oral and dental pathology. With this epidemiological research it’s now possible to present accurate results, based on an effective and systematic clinical data collection.

It is intended during the presentation to show some clinical examples reflecting the reality found in animals belonging to these endangered breeds, as well the latest statistic results obtained during the epidemiological research field work.

DISCUSSION

Given the severity of some clinical cases presented, the proposed epidemiological study by the author is assumed to be of paramount importance, in order to better understand the pathological situations that affect these animals, improving not only their welfare but also preserving a unique genetic heritage in the world.

ACKNOWLEDGEMENTS

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Treatment of a mandibular canine fracture in two bears: two clinical cases

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Abstract

The paper describes a treatment of mandibular canines fractures in two bear species - the Brown Bear (Ursus arctos) and the Polar Bear (Ursus maritimus). The bears were treated in 2004 and 2010, respectively. In both cases, the treatment procedures had to adapt to the field conditions and technical limits. Initially, both patients were treated with antibiotics, but when the conservative treatment failed, the owners decided to pursue the dental exam. At the time of the procedure, both patients were put on antibiotics (amoxycillin clavulanate, 25 mg/kg/day). The first patient - the Brown Bear - showed clinical signs of periapical parodontitis. It was anesthetized with an intramuscular injection of medetomidine (30 µg/kg) and 10% ketamine (2 mg/kg), and after the sedation, the anesthesia was maintained with a propofol intravenously. The endodontic treatment procedure was performed on both mandibular canines (304, 404). Radiography and check-ups were not possible to carry out due to technical difficulties. The desinfection of the pulp cavity was performed with a gradual administration of hydrogen peroxide and sodium hypochlorite. The endodontic cement with eugenol and paraformaldehyde, glass ionomer cement, and amalgam were used for a filling. The problem reoccurred after the treatment procedure, but disappeared after repeated antibiotic therapy. The either patient - the Polar Bear - showed less profound clinical signs, but a canine fracture was observed. The anesthesia was induced by a distant technique (using a blow pipe) (7,35 mg of etorphine hydrochloride per animal), radiographic examination was performed and the affected tooth was extracted. The tooth was primarily affected by a developmental disturbance called "dens in dente".

Introduction

The frequency of the tooth fractures in carnivores in the zoological gardens appears to be the same as in dogs and cats. The injuries remain hidden for a long time until diagnosed, as the regular oral check-ups are not possible in such animals and the problem initially stays asymptomatic (Kitchener 2004, Bourne a kol. 2010). If there are some clinical signs after a tooth fracture and pulp cavity exposure, they are usually mild and remain unnoticed. The injury and secondary pulpitis are painful. After a dental pulp devitalization the pain ceases (Wiggs a Lobprise 1997a, Eriksen 2007). The apparent clinical signs are not usually observed prior to the infection moves through apical delta and the periapical parodontitis occurs (Fichtel a kol. 2004). Then, jaw swelling, edema, and purulent fistules may be observed. This condition may be linked to the pain that might cause a difficult eating and weight loss (Wiggs a Lobprise 1997a, Eriksen 2007). The owner usually seeks for a veterinary help as late as the moment. Diagnosis and therapy are basically the same as in dogs and cats. The differences are linked to the species specifics, handling the zoo animals, size of the animal, and technical limits of the area the animal is kept in. The bear’s dental formula is 3 1 3-4 2 for maxilla and 3 1 3-4 3 for mandibula. The total number of teeth is 40-42. The incisor and canine morphology is closely related to the carnivore type of dental formula, however, premolars and molars are relatively small and their shape
correspondes with an omnivorous lifestyle. Their shape resembles the shape of the same teeth in humans or pigs (Sacco a Van Valkenburgh 2004, Hillson 2005). The canines are so large that the dental instruments routinely used in small animals can be used in a bear only with a noted difficulty, or cannot be used at all. Such patients can hardly be transported to the specialized facility equipped with the required dental machines. The difficulties are obviously linked to such animal handling and also to the technical and financial abilities of the owner.

Case one

Patient: the Brown Bear (Ursus arctos), female, approximately 5 years of age. The animal was found abandoned on the car park in 2003, when the circus (former owner) moved abroad and stopped taking care of the animal anymore. History: After the animal had been placed to the facility offered by a local municipality, the personnel noticed the mandibular swelling, inapetence, and an increasing bear’s aggression. The antibiotics were given (amoxcillin clavulanate, 25mg/kg/day). The signs subsided temporarily, but at the time the antibiotics were withdrawn, the condition reoccurred. The owner asked for a clinical examination in the place.

Dental examination: The patient was treated in 2004. At the time the animal’s oral cavity was examined, the bear was put on antibiotics (amoxycillin clavulanate, 25mg/kg/day) and there were no signs of the disease. The anesthesia were induced with medetomidine (30 µg/kg) and 10% ketamine (2 mg/kg) given intramuscularly, devided into two doses. After that, the catheter was placed into a cephalic vein and propofol administered.

The standard clinical endodontic examinantion of the canines 304 and 404 was performed. Radiology was not performed as it was impossible to carry out the exam in the place. In both teeth the fracture plane was adjusted and a pulp cavity exposed. The necrotic pulp was then extirpated, and the pulp cavity extended. Owing to the size of the teeth, the standard dental endodontic equipment (60 mm of length) appeared to be adequate. Hydrogen peroxide (3%) was used to wash out and desinfect the cavity, followed by a lavage of 3% solution of sodium hypochlorite for 30 minutes. When dried out, the cavity of both teeth was filled with the endodontic cement (Endofil) and gutta percha plugs. The crown cavities were filled with a glass ionomer cement and amalgam. Two months after the procedures, the mandibular swelling reappeared, and antibiotic treatment was iniciated. Since that time, the pacient has been asymptomatic.

Case two

Patient: the Polar Bear (Ursus maritimus), male, 12 years of age. The owner is the ZOO Brno. History: The personnel of the zoo noticed the problems while fed, including a salivation, and increased anxiety. After closer observation, the canine fracture (304) was identified. The animal was put on antibiotics, but when withdrawn, the problem reoccurred immediatelly. The local veterinarian asked for advice and clinical examination in the place.

Dental examination: The patient was treated in 2010. At the time the animal’s oral cavity was examined, the bear was put on antibiotics (amoxycillin clavulanate, 25mg/kg/day). The anesthesia was induced with etorphine and acepromazine (Imobilon LA) with a total dose of 3 ml (7,35 mg etorphine hydrochloride) given
intramuscularly by a distant technique (using a blow pipe). The affected canine had a distal third abrupted and in its pulp cavity there was a well defined enamel-like structure. The crown abrasion was observed on incisors and other canines, both 303 and 403 showed an opened pulp cavity and were partly loosen. Radiographic examination of the mandibula was performed. The secondary tooth structure located in a pulp cavity was identified in canine 304 on radiograph. The radiolucent zone was also observed in periapical region, and the bone surrounding the tooth appeared to be structurally changed. Based on the radiological findings, we decided to extract the affected tooth. The mucous membrane was removed and mandibula was exposed up to the mental foramen. The bone tissue of the alveolus was of a poor quality and it was possible to remove it quite easily. We used an orthopedic curved cutter (20 mm of width) for the tooth luxation. The cutter was shaped in a way to trace the extracted tooth surface. Using the hammer, we got the cutter into the periodontal region on the lingual surface of the tooth and by a pressure exerting on the surface we luxated the tooth laterally. When the tooth was loosen enough from its alveolus, the extraction was performed and developed sharp edges made even. The wound was closed with Vicryl plus 3-0. The incisors 303 and 403 were extracted by a standard technique. The extracted canine was submitted to a histopathological examination. The results have not yet been revealed up to the writing the paper, but a developmental disturbance "dens in dente" may be assumed. At present, the patient is asymptomatic and eats normally.

Discussion

The treatment procedures were in both cases performed in the breeding facility, because the option seemed to be more acceptable for the owner compared with a transport of the animal to a clinic. This was done despite the fact we had to improvise and accept the lower standard of the procedure. The absence of the radiographic examination after the endodontic treatment bears a higher risk of a treatment failure. This might be due to a severe apical parodontitis with a persistent infection in apical delta, or incompletely filled pulp cavity (Eriksen 2007). The cement with formaldehyde and eugenol, that is able to keep away the complications caused by a persistent infection, was used for filling in order to lower such risks (Wiggs a Lobprise 1997c). The amalgam filling material was used due to its high endurance. The disadvantage of the filling material is a lack of adherence to the hard dental tissues. The retention of the filling material was ensured by a cavity divergence (Wiggs a Lobprise 1997d). If the endodontic treatment had failed, the best solution - from the financial and technical point of view - would have been an extraction (Wiggs a Lobprise 1997c). The extraction was chosen as a primary solution in case of the polar bear due to an abnormal tooth structure and findings of the periapical lucency and alveolar bone changes. Owing to the poor bone tissue quality, using of the manual instruments appeared to be preferable. Assumingly, the healthy alveolar bone would have had to be prepared with a rotary machine. The lateral approach to the mandibular canine extraction is not usually recommended due to possible damage of the vessel and nerve coming from the mental foramen (Wiggs a Lobprise 1997b). In the case though, the lateral approach enabled a fast extraction, which is the reason why we preferred such a technique. The mental foramen remained intact.
References:


**Actinomycosis in a chinchilla**

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**Introduction**

Diseases of the oral cavity are common in rabbits and small herbivorous mammals with completely elodont dentition. Different forms of congenital, developmental or acquired dental disease induce signs of hypersalivation, anorexia, chewing disturbances, changes in food preferences and poor body condition. Dental disease can also be accompanied by the development of facial abscesses, wet dermatitis, epiphora, exophthalmia and damage to the temporomandibular joint. Despite similar anatomy and physiology of teeth, guinea pigs and chinchillas seem to be much less prone to periapical infections and osteomyelitis than rabbits. It is still unclear why, despite frequent perforation of the cortical bone by deformed apexes in chinchillas, the aim of this article was to describe a clinical case of maxillary and zygomatic arch osteomyelitis in a chinchilla.

**Case presentation**

A 2-year-old, 470g, female chinchilla was presented with decreased appetite, excess salivation and swollen chin of 8-days duration. A history obtained from the owner revealed that the chinchilla was kept alone in a wire cage containing a wood-shaving substrate and fed a diet consisting of commercial chinchilla food (mixture of pellets and seeds), fresh vegetables, and grass hay. On presentation, the chinchilla appeared mildly depressed, showed lower body condition and an uneven coat. The other abnormalities seen during physical examination were serous unilateral epiphora, rounded, fibroelastic mass with a diameter of approximately 2 cm localised cranial to the medial eye canthus. Abdominal palpation revealed small amount of intestinal and caecum content.

After oxygen therapy, an initial conscious oral cavity examination was performed with the use of a paediatric laryngoscope. Significant cheek teeth malocclusion with spike formation and tongue erosions was noted. No nasal discharge or any other abnormalities were detected.

The chinchilla was given butorphanol at 0.4 mg/kg IM for analgesia. The patient was placed on a heating pad maintained at 39°C and given 10 ml/kg of an isotonic electrolyte solution subcutaneously. A detailed examination of the oral cavity was performed with a rigid endoscope under isoflurane anaesthesia. Dorsoventral, lateral and rostrocaudal radiographs of the skull were obtained, and then the animal was allowed to recover. Haematological and plasma chemistry analyses revealed low haematocrite, low haemoglobin level, mild hypochromia, improper plasma calcium to phosphorus ration and elevated ALP. There was widening of the interproximal coronal surfaces, coronal elongation of nearly all the cheek teeth, and abnormal cheek teeth occlusal surfaces. Evaluation of the soft tissues revealed gingival hyperplasia. Skull radiography and computed tomography (CT) imaging showed moderate malocclusion of the premolars and molars which were elongated apically. On CT, there were obvious osteolytic lesions of rostral zygomatic arch and the maxillary area lateral/buccal to the apex of maxillary right second molar. These findings were consistent with periapical infection of second maxillary molar and
maxillary and zygomatic arch osteomyelitis. Bacteriology results showed the presence of beta-haemolytic Streptococcus, Enterococcus faecalis and Actinomyces odontolyticus.

Therapy consist of supportive care (electrolyte fluids, gastrointestinal tract prokinetics, vitamins C and B), analgesia (meloxicam 0.5 mg/kg SQ bid, butorphanol 0.4 mg/kg bid IM) and antibiotics (marbofloxacin 10 mg/kg sid IM, metronidazole 20 mg/kg bid PO). Surgery consists of rostral zygomatic arch removal, curettage and debridgement of affected areas of soft tissue and bone and second molar extraction and marsupialisation. Recovery was uneventful and patient was sent to homecare three days after the surgery. In 4 days interval the wound was cleaned and KMnO4. Antibiotics were discontinued after next seven days. The wound healed completely in three weeks.

Discussion and conclusion

Chinchillas with advanced dental disease seem to commonly suffer from periodontal disease. A study of Crossley (2003) recorded periodontal disease in 63% of the captive chinchilla examined. The lesions ranged from a roughened or irregular alveolar crest to severe bony defects, sometimes with displacement of the teeth. Food remained impacted between the teeth and in deep periodontal pockets in many specimens. Based on authors’ experience, cheek teeth inflammatory changes are in rabbits commonly seen at the area of tooth apex. In present case, the inflammatory process perforated the alveolar bone and maxilla buccally and approximately in the middle of the reserve crown. Authors suggested that this could be related with periodontal disease and bone perforation in its thinner thickness.

Computed tomography showed to be the most appropriate method not only for diagnostics but also for surgical planning in this case.

Bacterial pathogens commonly involved in periapical lesions in rabbits are Fusobacterium nucleatum, Prevotella heparinolytica, Prevotella spp., Peptostreptococcus micros, Streptococcus milleri group, Actinomyces israelii and Arcanobacterium haemolyticum. Actinomycoses odontolyticus, which was diagnosed in present case, is found to be pathogenic also in humans and cause jaw abscesses as well as abscesses in soft tissues. Authors recommend taking special attention especially in cases where the chinchilla comes into the contact with immunocompromised people, in which could be fatal.

Conservative treatment of facial abscesses is in abscesses is in small pet mammals general frequently unsuccessful because of aggressive capsule formation and the development of fistulous tracts and osteomyelitis. The thick consistency of pus makes aspiration and drainage of these abscesses very difficult and antibiotic therapy problematic. Therefore, surgical excision of the abscesses together with marsupialisation is the best treatment option.

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Recommended reading

Effect of improper dietary mineral content on incisor microstructure of degus

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Introduction

Acquired dental disease or syndrome of dental disease is the most common health problem in small herbivorous pet mammals with completely elodont dentition (Legendre 2002, Crossley 2003, Capello et al. 2005, Harcourt-Brown 2009). Dental disease was diagnosed in 38.1 % of rabbits, 23.4 % of guinea pigs and 32.5 % of chinchillas (Jekl et al. 2008). However, the results do not include lesions that are mainly detected radiographically, as radiographic assessment was not included in this study, and the true incidence of dental disease will therefore be higher. Inadequate dental wear and metabolic bone disease are the two most popular explanations for this syndrome in rabbits (Crossley 2005, Harcourt-Brown 2006). Among small mammals with completely elodont dentition, degus older than two years seems to be very prone to dental disease with the prevalence up to 75 % (Jekl et al. 2011).

The aim of this study was to examine incisor microstructure of experimental degus fed by high phosphorus and improper calcium and phosphorus ratio and to compare these incisors with control animals.

Materials and Methods

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 2 equal groups in the age of 3 months and were fed by a diet with different mineral content (Group A - calcium 13.2 g/kg d.m.b., phosphorus 6.3 g/kg d.m.b. and group B - calcium 9.1 g/kg d.m.b., phosphorus 9.5 g/kg d.m.b.). 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 (accreditation No. 46613/2003-1020).

Degus were clinically examined regularly and euthanized at the age of 17 months. For the purpose of this study right mandibular incisors were examined. Apices were examined after decalcification in EDTA by histopathology and visible crowns were examined by scanning (TESCAN VEGA TS XM 5136 scanning electron microscope) and transmissible electron microscopy (FEI Morgagni 286 D electron microscope).

Results

In group A, all incisors were dark yellow to orange pigmented for entire experimental period and no incisor malocclusion was seen. Degus from group B had depigmented all incisors. Incisors of this group were white in colour, fractured easily and the labial surface was rough on palpation. Incisor malocclusion and crown elongation was obvious in group B.
On histopathology, disruption of ameloblasts and stratum intermedium patterning, the presence of vascular inclusions and altered arrangement of odontoblasts were obvious. Moreover, epithelial pearls were formed on the enamel surface.

By scanning electron microscopy the surface of degus incisor enamel from group A was smooth in comparison with group B, where obvious pitted appearance and surface defects with loss of the superficial enamel layer were recorded. The enamel surrounding defects appeared also abnormal.

The peritubular dentine of group A appeared in transmissible electron microscopy as a homogenous mass with sparse pale collagen fibres, which were seen mainly on transversal section. Fibres of the intertubular dentin were usually arranged longitudinally. Amorphous material of peritubular dentin was clear and homogenous. Group B had the peritubular dentin with areas, which appeared like impregnated with inorganic salts remains. Collagen fibres were less regularly arranged. Previously observed differences between peritubular and intertubular dentin as in group A were largely blurred.

Discussion and conclusion

During tooth eruption various stimuli can cause disruption that can be grossly manifested in the erupted tooth. Inflammation, trauma, infection, systemic disease, and endocrine activity can all adversely affect proper formation of enamel, dentin, cementum, roots, pulp and alveolar bone (Koch et al. 1999). It has been clearly shown that ameloblasts belong to the most sensitive cells of the human body (Lygidakis et al. 2008). Therefore, if their function is interrupted, temporarily or permanently, then depending upon the time of insult, enamel hypoplasia or hypomineralisation is probably the most common sequel seen from many of the above mentioned influences, which will result in a softer, discoloured, chalky, pitted-enamel surface (Fearne et al. 2004, Lygidakis et al. 2008). Rodents, where the incisors are elodont and eruption time of mandibular incisors could be as quick as 1 mm per day (Main and Adams 1965), are therefore very sensitive to any of the above mentioned factors.

In rabbits, enamel pathology is seen as horizontal ridges across the teeth, especially the upper incisors. Radiographically, loss of enamel is seen in the longitudinal enamel folds in the cheek teeth, which become thin and indistinct (Harcort-Brown 2009). In present study macroscopically visible enamel depigmentation was obvious, suggesting severe negative impact of HPD and improper calcium to phosphorus ratio to enamel formation. Moreover incisors were more fragile which commonly resulted in their fracture.

In contrast to the regulation of calcium homeostasis, which has been extensively studied in humans over the past several decades, relatively little is known about the regulation of phosphate homeostasis (Bergwitz and Jüppner 2009). Enamel hypoplasia or hypocalcification has been reported in metabolic disorders in humans and laboratory animals in which hypocalcaemia (Nikofurok and Fraser 1981, Lozupone and Favia 1989, Nanci et al. 2000) were a major sign (vitamin D deficiency, prematurity, neonatal tetany or hypoparathyroidism).

Bone and dentin are mineralized tissues that closely resemble each other in composition and mechanism of formation (Mjör 1985, Qin et al. 2004). Therefore, it is convenient to attribute the dentin hypomineralisation to the abnormal calcium to phosphorus ratio (Zhang et al. 2009), which was recorded also in present study. Disruption of function of the ameloblasts and odontoblasts, seen in present study seems to be similar to human hypoparathyroidism, pseudohypoparathyroidism.
(Ritchie 1965, Pavlic and Waltimo-Sirén 2009), where high phosphorus levels are also present. In contrast, presence of larger amount of globular dentin was also described in patients with rickets (Seow et al. 1989) under hypophosphatemic conditions. Nikiforuk and Fraser (1981) stated that the occurrence of enamel hypoplasia bore no relation to the plasma phosphate concentration. Enamel defects seen in present study were similar with above described effect of low calcium diet, despite the fact, that calcium dietary levels were in upper recommended dose for the degus (Edwards 2009), diet was high in phosphorus and had improper calcium to phosphorus ratio.

The present study shows that enamel and dentin development is disturbed under high phosphorus diet and improper calcium to phosphor ratio. Disturbed mineral metabolism resulted in enamel hypoplasia, enamel pitting and altered dentin. Degus could be used as an experimental animal model for the study of the developmental teeth disturbances.

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Morphological Study Of Root Surfaces In Teeth With Periodontal Disease. Preliminary Results.

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INTRODUCTION

The radicular resorption is a completely normal process that occurs in the decidua teeth. However, it is infrequent in permanent dentition, where it can be produced as a result of inflammatory conditions, excessive mechanical or occlusal forces, teeth reimplantation, tumors and cysts, teeth impaction, and idiopathic causes 10. In humans, although many studies have been carried out on radicular resorptions (most of them refered to orthodontic treatment), only a few are related to periodontal disease1, 3, 9.

In dogs, there are some reports about ideopathic dental root resorption, a very common dental condition in cats and also seen in many other species, but only occasionally in dogs. However, no paper has been found relating root resorption with periodontal disease.

The purpose of this work was to describe the defects in the cementum of teeth with periodontal disease, seen with scanning electron microscope (SEM), especially the presence of resorption areas.

MATERIALS AND METHOD

Teeth involved in periodontal disease were obtained from patients that needed exodontia (attended at the Surgical Service of the Veterinary Teaching Hospital or on the Dental Service, Faculty of Veterinary Sciences, Buenos Aires University). In each case a periodontal examination was done to stadify the level of periodontal disease. The following parameters were registered: pocket depth, root exposure, plaque index, calculus index, gingival index, sulcus bleeding index, mobility index, furcation exposure; and also the breed, sex, age, and feeding of each animal. Radiographs were also taken prior to exodontia.

The teeth were prepared for SEM (Philips® XL 30) observation. The vestibular surface of each tooth was scanned at 200X in order to look for cementum resorptions. One digital SEM photomicrograph was taken at each resorption and at the whole vestibular face where the defect location was marked with an arrow. The area of each resorption and its distance to the cementoenamel junction were measured with the software Image Tool 3.0 (UTHSCSA). This information was used to determin the location characteristics of each resorption: the radicular third in which it was produced and if the cementum was exposed, attached or inside the pocket.

The radiographs were used to determine the percentage attachment loss (PAL) in order to classify the teeth, according to the veterinary periodontal disease index 13, in 4 groups. Table 1.

260 resorptions were seen in 43 roots of 26 teeth, belonging to 7 different dogs (mesocephalic, between 5 and 13 years old and 5 to 12 kg of weight). Four roots belonged to group 2, seven to group 3 and 32 to group 4. This numeric difference was due to the difficulty in obtaining teeth with low stages of the disease. A control group of six teeth was also studied, extracted from two dogs without clinical or
radiological signs of periodontal disease (mesocephalic, of 2 and 3 years old and 12 and 15 kg of weight).

RESULTS

The exposed acellular cementum appeared very similar to the anorganic preparations of normal acellular cementum 12, with resorption areas of variable sizes – from 300 µ² to the whole tooth surface (Fig. 1). The same happened with the cellular cementum, with the intrinsic fibres well mineralized and sometimes more prominent than the Sharpey fibre ends. Most of the teeth had small deposits of calculus.

No resorptions were found in the control group. Five of the 43 roots, studied of teeth with periodontal disease, did not show resorptions (11.62%). Four of them belonged to group 4 and one to group 3.

The 72% of the teeth had resorptions in the gingival third, 62.79% in the middle third and 39.53% in the apical third.

The 79.8% of the resorptions were found in the exposed root, 17.7% in attached cementum and 11.5% in the pocket.

The distribution of the resorptions areas by groups is shown in table 2.

DISCUSSION

The human cementum surface in periodontal disease, has been described using SEM in some papers 2, 7-8. They found a surface similar to the anorganic preparations of normal acellular cementum, with resorption areas and small particles of calculus – the same as we did in the current work.

The SEM has been successfully used in the study of radicular resorptions associated with orthodontic tooth movement 5-6, 11 and periodontal disease 1, because it permits a complete visualization of the cementum surface. Therefore, it has been shown to be helpful for detecting and localizing root resorption areas, been able to measure them and even see if they had spread as far as the dentin. The use of histologic sections or radiographs for studying root resorptions may lead to missing areas of resorption or their overestimation 5, 11.

In human studies, the majority of the resorptions were located in the radicular apical third, not only in unhealthy teeth but also in healthy ones. Only a small fraction was found in other locations 1, 4, 9. These reasons seem to show that inflammation is not an important factor in the etiology of resorption in human teeth. On the other hand, in our study, most resorptions were located in the gingival third and in exposed cementum while none of them were found in healthy teeth. These results could indicate that inflammation associated with periodontitis has an important role in the resorption production in dog’s teeth.

CONCLUSIONS

More investigations are needed, specialty in teeth with low stages of the disease, 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

Comparison Of Cementum Surface In Teeth Of Dogs and Cats, Using Scanning Electron Microscopy

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Introduction

The cement covering the root surface dental is considered the least hard tissue has data. Reports mention about this subject the study of surface morphology root by Scanning Electron Microscopy (SEM) is which allows for the greatest amount of data on connective tissue fibres (extrinsic and intrinsic) that comprise it1. The bibliography cites particular studies done in humans and some animals using optical microscope, transmission electronic and scanning2. Researches about the subject in dogs3 and cats4-5 are very scarce, and none comparing both species. Considering the importance of knowledge of this tissue component of the periodontal ligament and impact site to many oral diseases in pets, the main purpose of this study was to compare the characteristics of the cementum surface defining the different patterns of Sharpey fibres distribution and their diameter, in permanent normal teeth of dogs and cats.

Materials and method

The study included 37 roots (from 19 incisors, 9 first premolars and 6 second premolars) removed from 7 dogs (3 Cocker Spaniel, 3 cross bred and 1 Labrador Retriever, 2 female and 5 male, aged between 4 and 14 years old, whose weight varied from 15 to 30 kilograms), and 38 roots (from 9 canines, 7 third premolars, 8 fourth premolars, and 3 lower first molar), obtained from 4 cats (all DSH, 3 female and 1 male, aged between 4 and 8 years old). These animals died of natural causes or underwent euthanasia because of a terminal disease. Careful after extraction, each tooth (root) was examined, in order to discard those defects or with injuries, only teeth with no radiographic or clinical signs of disease, were used. Each tooth was prepare 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 roots), at 1500X. The density of extrinsic fibres was determined in one area of 600 square micrometers. In each photomicrograph the diameter of 30 Sharpey fibres was measured, selected at random, in a mesio – distal way. 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 thirds of the root and species were tested for significance by Student\'\'\'s t-test (p <0.05).

Results

Cementum surface pattern: Compared with the dog, cementum characteristics of the cat in relation to architecture and arrangement of Sharpey fibres expressed in a more orderly and organized. Regularly distributed Sharpey fibres bundles as the main pattern in the cervical third of the root (Fig 1A and 1B). In both species. In dogs, the insertion sites of the Sharpey fibres bundles were densely grouped, being almost 100% of the surface occupied by them. In cats, the 70% of the roots were examined
showing this pattern. Both presented, in only some cases, a type of insertion sites of the Sharpey fibres as depressions on a smooth surface. In no case observed cell lacunae. In the apical third of the root, the intrinsic fibres run between the extrinsic fibres with a different orientation (Fig 2A and 2B). The density of extrinsic fibres was less than the cervical third. In dogs, this percentage ranged 40% to 50% of occupied surface in all cases). In cats, 60% coincided with the values found in the occupation dog while 40% of the samples showed a density of Type 3. In this third, some surfaces presenting cell lacunae. Diameters of the extrinsic (Sharpey) fibres (in micrometers) were measured directly from the micrographs, and were grouped according to third root and species. Results are listed in Table 1. By Student’s t-test compared the diameter of extrinsic fibres between the two species, with significantly higher in both regions studied (third of the root) in the dog (p <0.0000).

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>Cervical root</th>
<th>Apical root</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dog</td>
<td>5.22 +/- 0.95</td>
<td>5.38 +/- 1.33</td>
</tr>
<tr>
<td>Cat</td>
<td>4.49 +/- 1.59</td>
<td>4.46 +/- 1.30</td>
</tr>
</tbody>
</table>

Table 1: Diameter of extrinsic (Sharpey) fibres according to specie and root regions (results are expressed in micrometers as mean ± SD)

Discussion

The cement surface in both species maintained a general architecture (distribution and density Sharpey fibres) similar to that described in literature, mainly in studies on human’s teeth. The best preserved structure was found in cats, with less variation in distribution and shape of extrinsic fibres. In relation to density, both species had a decreasing relative density coronal-apical, but the apical third cat had a lower percentage fibres than the dog. There were differences significant between extrinsic fibers size among the studied species, being in both locations, larger in dogs than in cats, even though both species showed a smaller size than the ones found in humans (measurements lies at 6 micrometers with few fibres less than 4.5 micrometers or more than 9.5 micrometers diameter).

Conclusions

These findings allowed to characterize the surface cement in dogs and cats. The general structure cementum surface in both species layout and density of Sharpey fibres, similar to those reported by other authors studies on human teeth. The results of this study may be useful for future investigations, not only veterinarian but also human, being able to use the teeth of both species as experimental model. Standardization a pattern of normal structure will also allow recognize the extent of various oral diseases (eg periodontal disease, odontoclastic reabsortive lesions) on the normal anatomy of the cementum.
References

Nontonsillar squamous cell carcinoma – A malignancy masked as a stomatitis

MVDr. Petr Janalík, MVDr. Tomáš Fichtel, Ph.D.

Oral squamous cell carcinoma in the dog and cat should not be underestimated, as it is one of the most common oral malignancies in these animals. Although the clinical symptoms are not specific, appropriate diagnostic techniques like diagnostic imaging and histological examination of biopsy sample should be chosen. If the tumour is operable and the overall patient’s condition allows it, the surgical treatment is the recommended method and can be supplied with the radio- and/or chemotherapy. The prognosis depends on a couple conditions like animal species, length of the disorder presence, tumour localisation, extension of the surgery, adjacent therapy, secondary diseases etc. The client should be acquainted with the probable benefits of all treatment options while the SCC tumour cases are quite common lately diagnosed. However, careful diagnostics remain the best prevention of further complications.

Introduction

Squamous cell carcinoma (spinocellular carcinoma, SCC) is the second most common oral cavity malignancy in the dog and the most common one in the cat (Leibman and others 2003). It can be localised on the gingiva, tongue and tonsils (Withrow 1997). Tonsillar tumours are different in some aspects, therefore aren’t described in this review. This type of neoplasm is most frequently being found in the animals which are elder than 9-10 years, without any sex or breed dependence; in the dog, there was described a papillary form of SCC which occurs primarily in animals younger than two years. The tumour is localised most often in the rostral maxillary region (in the dog), in the ventrolateral part of the tongue, on the tongue’s phrenulum or on the mandibular gingiva (in the cat) (Wiggs and Lobprise 1997, Leibman and others 2003).

Clinical manifestation

The symptoms are not significantly different than in other oral cavity tumours and often even in inflammatory lesions of the oral cavity; due to that, SCC (as well as the other tumours) is often misinterpreted or lately diagnosed. The common symptoms are swelling, hyperaemia, ptalism, halitosis, nodular, flat and/or ulcerated mass, eventually the face asymmetry (Wiggs and Lobprise 1997, Leibman and others 2003).

Diagnostics

The diagnosis should be based on the diagnostic imaging (X-rays, concretely, which should reveal presence of the jaw bone lytic process, and/or computing tomography, which determinates the extension of the tumour even better than X-rays) and histological examination of the biopsy sample (to differentiate SCC from amelanotic melanoma, fibrosarcoma, gingival hyperplasia etc.). From the above mentioned facts it is clear that especially in the flat nontonsillar form of tumour in the early stages, there is a danger of wrong diagnosis as a common oral cavity inflammation – stomatitis. This often happens because the opposite teeth hurt
the tumour’s surface and, in fact, a secondary inflammation develops itself. Such cases are then treated as a stomatitis and the common therapeutic scheme (antiflogistics, antibiotics) shows only intermittent success (due to the secondary inflammation). Logically, there lacks the complete healing of the process and it worsens again every time the medication is interrupted. The way to the right and early diagnosis is not simple, nevertheless it is one of the crucial prerequisite for the successful treatment of the SCC. Critical moment in the diagnostics is the biopsy of a sufficient depth – the superficial samples contain often only the marginal inflammatory cells (Withrow 2001, Bellows 2010). The metastatic activity is considered to be low; when the metastases occur, they affect most often the regional lymph nodes. As a confirmation method, the fine needle aspiration biopsy or a common incision biopsy of these lymph nodes is recommended even in the cases where lymph nodes are not enlarged (Leibman and others 2003, Bellows 2010).

Therapy

The surgical therapy is recommended – the tumour should be excised including the lytic bone (if present) and a broad margin of the healthy tissue. This is the basic prerequisite to minimise the risk of relapse. In fact, this often means segmental or even total mandibulectomy/maxillectomy. Post operatively, a radiotherapy or chemotherapy (cisplatin, carboplatin, piroxicam) can significantly improve the effect of surgery (Leibman and others 2003).

Prognosis

There are some factors which influence the prognosis. In general, the younger patients are, the longer survival time can be expected. The localisation of the tumour plays an important role too – tumours of the mandible have better prognosis than the maxillary tumours, as well as the rostrally localised tumours compared to the caudally localised. The tongue affection is more aggressive than the gingival neoplasm; it should be noted that the cats withstand even the partial tongue resection much worse than the dogs. Of course it is clear that the earlier the tumour is diagnosed and treated, the better the prognosis is. Because of that, some authors recommend the biopsy of every suspicious oral cavity lesions and masses in all elder animals. The average survival time of the SCC in the dog is 18 months and 70 % of the dogs should survive one year or longer after the surgery; by contrast, only 10 % of the treated cats survive one year or longer after the surgery according to the literature (Withrow 2001, Wiggs a Lobprise 1997).

Discussion

If the veterinarian faces a suspicious lesion in the oral cavity, it is essential not to underestimate it. If there is not any positive effect on the standard anti-inflammatory therapy in a few days, further diagnostics should be done – X-rays, lesion/mass biopsy. The client should be informed about the importance of these examinations and consequences of the eventual neoplasm underestimation have to be described. Based on our workplace cases, it can be said that the client is often not willing to let his animal undergo the surgery even in the cases of positive diagnosis of SCC and evident clinical symptoms. From his point of view the investment in the expensive treatment is extremely doubtful – most often he comes with an old animal with
progressive SCC (and some secondary disorders like heart disease, renal disorders etc.). Even the cosmetic effect of the surgery plays a role in the client’s decision – much of them are feared that their animal should lose a part of (or a whole) jaw. Another problem is the poor relative and absolute accessibility of radiotherapy for our clients – there are two workplaces in our regions, but the price and the risk of repeated anaesthesia is for the majority of the clients too high. If the client should decide what to do with his animal with an operable SCC, he has to know that the procedure’s benefit can be a couple more months (or even one or two years in some cases) of survival compared to the conservative solution. At the same time there should be consulted the importance of the cosmetic effect of the surgery for the animal and that this effect is not often apparent. However, the most imperative principle for the veterinarian should be the ethical aspect; the consequential life quality should be always considered together with a surgery.

References:
Avian and Reptile Dentistry

Peter P. Emily, DDS Hon. AVDC

Zoo dentistry includes many and varied species. Avians present primarily with lost segments of the beak, beak fractures or beak malocclusions. Replacement of lost beak segments can be performed with dental acrylic, dental composite, threaded pins, and wire, ligature wire and cyanoacrylate. Congenital or traumatic malocclusion or “cross beak” is not uncommon, especially in parrots. Active rubber orthodontic ligatures and threaded pin anchors can effectively correct this form of malocclusion.

Like birds, the most common dental problem seen in reptiles is oral trauma. The same principals of repair as employed in avian dentistry are utilized. For example turtles can present with “beak” fracture. Dental acrylics, threaded Coltène/Whaledent TMS pins, and cyanoacrylate can work miracles with these cases. Although not a dental procedure, the repair of fractured turtle shells with dental materials is a common procedure.

Beak Fracture Repair Procedure – Materials and Methods

Note: this procedure will describe replacement of a lost beak segment, but can be utilized for most forms of beak replacement, fracture, or shell repair, with minor adjustment.

Beak borders adjacent to the lost of the beak segment are cleaned with a medicament of choice, such as Chlorhexidine and dried.

A Coltène/Whaledent TMS drill of 0.20 diameter is utilized to make several preparations on either side of the lost segment approximately 1.5 to 2 mm from the edge and 2 to 3 mm apart from the lost segment.

The preparations are carefully made with one single drill insertion. Moving the drill in and out more than once will over-size the hole preparation.

Self-threading 0.21 Coltène/Whaledent TMS pins are screwed by hand into the preparations to the depth of the beak tissue. Care must be exercised to prevent stripping of the preparation while placing the pins to prevent loss of pin retention. If there is misalignment of beak segments, they should be placed and retained in proper alignment prior to proceeding.

Soft 24- or 26-gauge ligature wire is woven around the TMS pins to form a basket, which also serves to stabilize the fractures segments.

Dental acrylic or composite is placed over the ligature wire basket and cured. The acrylic or composite and the TMS pins are finished to the proper anatomy with a diamond bur under irrigation. The replacement segment can be died or colored to the beak’s natural color.
Avian Prosthetics

Birds such as Ibis often undergo beak rot with loss of a portion of the upper or lower beak.

An acrylic prosthetic beak(s) is/are fashioned after the lost segment from an alginate impression of an intact specimen of the lost segment.

The prosthesis are sculpted to fit and placed into position with the use of Markley wire that is threaded into the retained segment and into the prosthesis.

The prosthesis are secured with acrylic and cyanoacrylate cement.

Avian orthodontics is not uncommon. Parrots and tucans, for example, with cross beaks can be corrected with innovative bite planes constructed with TMS pins and dental composite.