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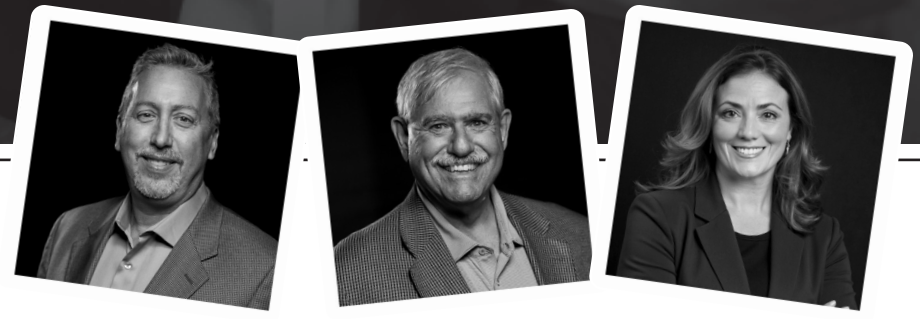

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Common Challenges with Dental Radiographic Interpretation and Positioning

Christopher Snyder, DVM, DAVDC, DEVDC

Intraoral radiography has evolved a great deal over the past 10 years. Initially it was only available through dental specialists and people with a comprehensive interest in dentistry. Now it has become readily affordable for the general practitioners and is commonly available in practice. The indications for dental radiography are variable and extensive, but being able to understand and interpret the results are paramount to identifying pathology and recommending the appropriate treatment.

Indications for Radiography

Missing, mobile, fractured, discolored teeth and teeth with periodontal pockets are all teeth that should undergo radiographic evaluation to determine treatment options. Teeth that are planned for extraction, for whatever reason, should be radiographed to aid in treatment planning, correct estimate creation and to appropriately counsel clients about potential complications. AAHA recommends that dental radiography be available in practice and research has demonstrated that more lesions are diagnosed radiographically than with gross oral examination alone. Radiographing procedure sites before and after a procedure also serves as confirmation that extraction was complete and can serve as a comparator if future complications arise.

Marketing Radiography to Clients

The information that intraoral radiography can provide is invaluable for correctly and accurately identifying abnormalities and recommending treatments that will improve the veterinary patient's quality of life. With ½ to 2/3 of the normally erupted tooth anatomically located below the gum line, educating the client about the health of the subgingival periodontal attachment as well as the vitality of the endodontic system can only be impressed through the evaluation of a radiograph. The use of acrylic models or "smile" books displaying "normal's" can be helpful at conveying to clients this valuable service.

Once radiographs have been taken, printing the radiograph images and including them with discharge instructions provide the client with something tangible which can help to validate the service, justify the charges and provides redundancy of the information in the medical record. In my experience, clients typically appreciate the images and discussing the treatment and its justification is more easily understood.

Normal Anatomy

Enamel and dentin are comprised of a greater percentage of mineral than bone, so they appear more radiodense. The periodontal ligament is primarily comprised of collagen so it should show as a distinct radiolucent line. The periodontal ligament should be thin, well demarcated, and of consistent width throughout the outline of the tooth. The pulp chamber is located in the center of the tooth root and should be of uniform diameter throughout. Whenever a radiographic abnormality is suspected, radiographic comparison is recommended of the contralateral or comparable tooth. Remember that as the tooth matures, the pulp chamber narrows as secondary dentin is produced. If a widened pulp chamber is identified compared to neighboring

or contralateral teeth, chronicity of the lesion is demonstrated. The younger the patient (the wider the pulp chamber) the more profound the difference will be in the amount of secondary dentin laid down in six months. Mature patients can have very little change in pulp chamber diameter from year to year.

Pathology

Bone loss: Loss of mineral opacity is typically seen in vertical or horizontal orientations. If there is regionalized horizontal bone loss, a chronic inflammatory condition likely exists in that are or there are multiple neighboring teeth severely affected by periodontal disease. Bone loss does not equal attachment loss, so if there is there is periodontal attachment at the level of the cementoenamel junction and signs of underlying vertical bone loss, those teeth are not as periodontally "sound" because of the quality of the soft tissue attachment holding the root. The connective tissue maintaining attachment to the tooth should be closely monitored for the development of periodontal disease. In the most extreme cases of bone loss involving mandibular teeth, dental radiographs can impress upon the client the risk of jaw fracture while performing the extraction.

Periapical radiolucency: Periapical radiolucencies are typically what practitioners are concerned with when looking for nonvital teeth. While correctly identifying lesions suggestive of tooth nonvitality are important when deciding to recommend treatment, radiographic assessment for the purpose of anticipating difficult or complicated extractions may be even more important. Widening of the periapical periodontal ligament space can be suggestive of pathology. Keep in mind that a 40% loss of mineral density is required for pathology to be noticeable on radiographs. Typically, secondary changes related to tooth nonvitality are found emanating from one, or all of the apices of the affected tooth. These lucencies can be of variable size but typically are clearly well demarcated within the bone because of the focal effect of the expanding lesion. Triangular shaped radiolucencies extending from the apices of canine teeth and mandibular first molar teeth are referred to as "chevron" signs. This can be a normal finding on these particular teeth and are not indicative of tooth nonvitality. If one is unsure about a radiographic finding, radiographing the contralateral tooth is recommended. Not every periapical radiolucency results from infection and represents a nonvital tooth. Differentials for these lesions include cemento-osseous dysplasia, sterile granuloma or an early stage cementoma. All of these lesions are thought to arise from pulpal inflammation and cannot be differentiated without histologic evaluation. Treatment for all these conditions would still involve root canal therapy or extraction- especially since our patients cannot definitively tell us whether or not they are experiencing pain.

Root pathology: Radiographic evaluation of tooth roots provide a tremendous insight into the difficulty or involvement of an extraction. Root fractures, extra roots and unusual root shapes (root dilacerations) are all conditions that directly influence the time and likely success of tooth extraction.

Root resorption/ankylosis: Presence of a periodontal ligament reassures the practitioner that a soft tissue separation exists between the tooth an alveolar bone which will serve as some "wiggle

room" for placement and action of the dental elevator. There are many causes for root resorption with inflammation being the most common. Instances where resorption has occurred but a periodontal ligament remains visible may demonstrate the tooth is weakened and may fracture during elevation. Instances of root resorption with ankylosis (bony fusion between cementum and alveolar bone) should prepare the practitioner for a more complicated extraction that will likely take longer. Older dogs with a history of being heavy or aggressive chewers will frequently exhibit ankylosis in dental radiographs. Extraction of these teeth typically take longer and may involve additional steps necessary for creating space for elevator placement. A practitioner should feel comfortable estimating a greater cost to the client to extract teeth that will be difficult.

Felines- Types of Tooth Resorption: Tooth resorption is a process very commonly noted in cats. Radiographic evaluation of the affected teeth is necessary to guide appropriate treatment recommendations. Since the process is a mixed destructive and proliferative condition, loss or involvement of the tooth crown may or may not be indicative of the extent of root involvement. Type I tooth resorption is defined as a radiographically present periodontal ligament structure. These teeth are treated with extraction since leaving remaining root structure behind to undergo replacement resorption is believed to be require inflammatory mediators which could contribute to discomfort. Type II resorption is defined as a tooth undergoing resorption where the periodontal ligament is no longer visible, indicative of replacement resorption having taken place. Crown amputation of these teeth are deemed acceptable (as long as other criteria are not met) since the root is believed to have already undergone replacement resorption and the act of trying to extract these teeth could cause more discomfort. Type III resorption is defined as a multi-rooted tooth demonstrating one root with a periodontal ligament present while another root demonstrates replacement resorption. The root with the periodontal ligament present should be extracted while the root undergone replacement resorption should be crown amputated.

Pulp Chamber Abnormalities: Occasionally radiographic evaluation of a tooth may demonstrate various abnormalities of the pulp chamber. Pulp chambers can be noted to be too large (indicative of tooth non-vitality and arrested dentin production), too small (pulp canal obliteration and accelerated dentin production may occur as a result of chronic inflammation or pulpitis) or contain mineralized material. Pulp stones are sometimes incidental findings in a pulp chamber. While pulp stones have very little clinical significance, unless root canal therapy was to be attempted around these mineralizations, these radiodensities are also believed to be the result of pulpal inflammation and those teeth should be monitored with serial radiographs. Internal root resorption can sometimes also be found on radiographic evaluation. Odontoclastic differentiation within the pulp chamber can result dentin resorption within the pulp cavity. These lesions should be differentiated from external root resorption by comparing multiple oblique angles of the same tooth. If the resorbing area does not move from the central location within the canal system, internal resorption is confirmed. External root resorption will result in the resorbing area being cast to the edge of the tooth root on oblique views.

Osseous Changes Associated with Benign and Malignant Pathology: There are really not many rules associated with the radiographic interpretation of oral masses and the correlation between

the process being malignant or benign. Generally speaking, benign processes can be destructive or productive when considering bone, however these processes rarely cause destruction to tooth structure. It is not uncommon for benign processes such as peripheral odontogenic fibromas (+/- ossifying type) and acanthomatous ameloblastomas to displace tooth structure while being seated in the alveolus. Squamous cell carcinoma, sarcoma family of tumors and malignant melanoma can all vary in the degree of bony involvement they display radiographically. At initial evaluation, radiographs should help direct the selection of appropriate tissue to be submitted for histologic evaluation. Any sort of mass causing bony change should include that aberrant boney architecture in the histologic submission. Radiographic evaluation should also help guide decision making for definitive surgical treatment of oral masses if computed tomography is not available.

Post-Procedural Radiographs

There are many circumstances where dental radiographs following extraction are helpful and provide the practitioner with reassurance that the job is complete. My recommendation is that a radiograph should always be taken at ANY time a root is suspected to have fractured during extraction. Gaining confidence is gross appearance of root structures after extraction and being able to compare them to pre/post operative films helps to build confidence. Post extraction radiographs may also be beneficial for sharing with clients at discharge to help justify procedural cost and objectify the pathology and the treatment. Printed dental radiographs provide the client with tangible information that can sometimes soothe concerns over client-perceived feelings that "unneeded procedures" were performed (you know, those clients who say their animal's mouth isn't painful but your exam and radiographs show otherwise!)

Occasionally you may have patients who have received advanced dental procedures (root canal, vital pulp therapy/pulp capping, crown placement.) Dental radiographs should always be taken of these teeth out of convenience if the animal is undergoing general anesthesia; this permits for ongoing monitoring of the dental treatment. Comparing immediate post treatment radiographs to present day films are usually necessary to comment on the success of the procedure. Be sure to share these films with whoever performed the original procedure and ask to be shown how to evaluate for evidence of treatment success.

Recommended Reading:

1. Atlas of Dental Radiography in Dogs and Cats. Authors: Gregg DuPont and Linda DeBowes 2008
2. Peralta S, Verstraete FJ, Kass PH. Radiographic evaluation of the types of tooth resorption in dogs. American journal of veterinary research. 2010 Jul 1;71(7):784-93.
3. Farcas N, Lommer MJ, Kass PH, Verstraete FJ. Dental radiographic findings in cats with chronic gingivostomatitis (2002–2012). Journal of the American Veterinary Medical Association. 2014 Feb 1;244(3):339-45.
4. Wiggs's Veterinary Dentistry: Principles and Practice. Lobprise HB, Dod JR. 2nd ed. Wiley Blackwell 2019
5. Radiograph set examples can be found here: https://avdc.org/radiograph-examples/

Periodontal Disease Part 1

Christopher Snyder, DVM, DAVDC, DEVDC

The success associated with the treatment of pathologic periodontal pockets rests on first understanding the underlying cause for the condition. Recognizing the increased depth of the sulcus (periodontal pocket) and acknowledging that the host's defense mechanisms against the bacteria in those pockets are designed to flush out the pocket and keep it clean, and then modifications to that local environment must occur. No matter how successful we are with treatment, successful periodontal rehabilitation relies on the client's ability to provide follow-up care.

Any source of infection in the body can be sufficient to stimulate a reaction resulting in inflammation. The process generates chemical and physiologic inflammatory mediators that result in the body's perception as pain. Periodontal disease has repeatedly been reported to impact up to 80% of dogs and 70% of cats over 3 years of age. Identification of both the gross evidence of disease as well as picking up on cues in the client's history can lead to client education, justification for further investigation and ultimately treatment and improvement in the pet's quality of life.

The most obvious signs of periodontal disease result in gingivitis, calculus accumulation and, in severe cases, gingival bleeding, gingival recession and root exposure. In less obvious cases, identifying unilateral (asymmetric) calculus accumulation or asymmetric gingivitis may be helpful at identifying subtle signs of disease. The absence of mechanical disruption of plaque by preferentially chewing on only one side permits the time needed for plaque to mineralize into calculus.

Periodontal Disease Staging

Periodontal disease is categorized by stages because it is a progressive process that is likely to continue to worsen over time in the absence of treatment or preventative measures.

Stage 0*:* Healthy periodontium (normal) and is the absence of attachment loss or inflammation. This is the desired state that we should strive to maintain in the pet's mouth. The normal sulcus depth of a dog is 1-3mm and <0.5-1mm in cats.

Stage 1: Gingivitis only. This is the only reversible stage of periodontal disease and exists with inflammation and an absence of attachment loss. Gingivitis is graded by stages (stage 1- inflammation only, stage 2- bleeding on probing, stage 3- spontaneous bleeding)

Stage 2: Mild Periodontitis can be defined by gingivitis and attachment loss commonly progressing to loss of supporting alveolar bone. The extent of attachment loss can be up to <25% the length of the root.

Stage 3: Moderate periodontitis is defined by the presence of gingivitis and 25-50% attachment loss of the length of the root which frequently involves exposure of the furcation of multi rooted teeth.

Stage 4: Advanced periodontitis includes the presence of gingivitis and >50% bone loss.

Multirooted teeth typically exhibit furcation exposure and without extensive efforts to rehabilitate the periodontal attachment, these teeth carry a very poor prognosis long term. Any multirooted tooth demonstrating furcation exposure is considered to have Stage 4 periodontal disease. Without heroic treatment, all stage 4 teeth should be extracted.

Instrumentation

The hallmark of accurate periodontal disease assessment hinges on periodontal pocket depth measurement (periodontal probe) and intraoral radiography. Intraoral radiography is more impactful for prognosis for successful periodontal treatment. Perio probes come in a variety of styles, some are even flat. It's most important to understand the markings delineated on the probe you're using to accurately measure pocket depth. Remember that normal periodontal pockets in dogs is 0-3mm and cats is 0-1mm.

Oral charting should take place measuring at least 6 locations around most teeth in dogs, and typically 4 locations around teeth in cats. Each tooth should be measured for periodontal pocketing as well as mobility, furcation exposure or evidence of dental trauma. Normal periodontal pocket depths don't need to be recorded on the oral exam chart. There are many variations of dental exam charts available on the market- use what makes the most sense for your clinic. The dental chart is part of the medical record and serves as an assessment of each tooth.

The most basic step of periodontal treatment is a dental cleaning. Dental cleaning is commonly performed with ultrasonic scalers. These scalers are either magneto-restrictive or piezoelectric. Depending on the technology you have in your practice, this governs the path that that ultrasonic cleaning tip moves in space. Because of the ultrasonic vibrations and movement of the scaler, it only functions where it can vibrate/move. Developmental grooves or close approximated teeth will inhibit the tip from moving which necessitates the need to also have hand instrumentation available. Periodontal scalers have two cutting edges, are sharp, and should only be used above the gumline. Subgingival curets have only one cutting edge (the down edge) and have a rounded toe which makes them safer for placement below the gumline.

All patients undergoing a dental scaling should be polished to remove micro abrasions which will trap plaque and facilitate quick return of plaque and calculus. Treatments below the gumline will be covered in a different lecture.

Home Dental Care

Numerous studies with various levels of evidence have been published regarding the benefits of various oral health products, techniques, and medications. These evaluations are rarely compiled together in a way that a logical approach to developing a home care "plan" can be formed for patients. I like to think of these different products or techniques as having positives and negatives and along with that, different efficacies for preventing periodontal disease. When considering these materials' functionality and efficacy as proven by the veterinary and human literature, a general tiered system can be used. Constructing a home care regimen is individualized for each patient.

Tier 1

Daily brushing remains the gold standard for the prevention of periodontal disease and maintenance of good oral health. Since veterinary patients are being brushed to prevent periodontal disease, rather than prevent cavity formation, brushing once daily is sufficient. Different studies show reduction of plaque or tartar based on various frequencies of brushing. Having the pet become accustomed to the toothbrush gradually can improve client and pet compliance. Pairing the brushing with a positive daily "reward" will create a pet who expects or seeks the tooth brushing activity. I recommend brushing once daily before feeding. By disrupting the subgingival bacterial matrix once daily, an environment which predisposes the gram-negative anaerobic bacteria to overpopulate is reduced. Human toothpaste should never be used in pets since the amount of fluoride contained in these products is not meant to be swallowed and may cause fluorosis of the kidneys. Veterinary research suggests that brushing with water versus veterinary toothpaste demonstrates no significant difference in the amount of plaque and tartar accumulation. Veterinary toothpaste tastes good to dogs and cats and functions more as a reward than a primary cause for plaque reduction.

Tier 2

Regarding food, in most situations dry food results in less plaque and tartar accumulation. Veterinary prescription diets such as T/D and Royal Canin incorporate technology which results in the fiber within the food to be orientated in a manner that predictably affects the way the kibble fragments when chewed. Repeated chewing creates a mechanical disruption of plaque before it can mineralize into calculus. Eukanuba/Iams and Royal Canin also make pet food products containing polyphosphates. Polyphosphates are responsible for chelating calcium found in saliva. When the salivary calcium is rendered unavailable to plaque, the process of plaque mineralization and subsequent calculus formation slows. Polyphosphates are bound to sodium in the dry form. The molecules dissociate in saliva. Prescription diets designed to be low in sodium (renal and cardiac diets) will not be labeled as having polyphosphates in the ingredient list. It has also been shown that a 50% increase in kibble size results in a 42% decrease in calculus formation in dogs. Increasing kibble size in cats results in a decrease in gingivitis.

Tier 3

Dogs who are heavy chewers are prone to fracturing the major chewing teeth (upper 4th premolars) when gnawing on hard objects. Careful selection of chew treats and toys should be made to avoid tooth fracture. A good rule of thumb for clients is- *"if you can hit yourself in the knee with it and it hurts, it's probably too hard for them to chew on."* Chew treats and toys offer a limited mechanism of periodontal disease prevention. While mechanical disruption of plaque may be helpful, the chew objects do not reach below the gum line where periodontal disease occurs. The Veterinary Oral Health Council website (www.VOHC.org) is a great source for clients and veterinarians to find reliable information about which oral health products work. Barrier sealants like Oravet have also been shown to reduce plaque and tartar buildup. While Oravet is not a replacement for brushing, it can be used in patients where daily tooth brushing is taking place.

Tier 4

The use of water additives, oral rinses and prescription antibiotics should be used carefully (and sparingly) in veterinary oral health management. An ingredient in some water additives include xylitol, which despite having antibacterial properties, also has a very narrow therapeutic margin and puts canine patients at great risks of xylitol toxicity. Oral rinses typically contain chlorhexidine or ascorbic acid which both functionally serve to have antibacterial properties. The ultimate problem with rinses and water additives, even when used properly, is that they do not penetrate into the targeted area where periodontal disease develops- subgingivally.

Conclusion

Early identification of periodontal disease and appropriate client selection can make for a rewarding experience when treating pathologic pockets associated with periodontal disease. Tooth preservation offers the benefit of quicker recovery than surgery, maintenance of tooth function, and improved general health from the perspective of fewer bacteria associated with intermittent bacteremia and inflammatory mediators in circulation. Commitment to home dental care efforts help support the body's ability to heal and should be emphasized as such when counseling clients.

Recommended reading:

1. Zetner K, Rothmueller G. Treatment of periodontal pockets with doxycycline in beagles. Vet Ther. 2002; 3(4):441-52
2. Holmstrom SE, Fitch PF, Eisner ER. Periodontal therapy and surgery in *Veterinary dental techniques for the small animal practitioner*, 3rd edition. Saunders, Philadelphia PA, 2004:233-43
3. Lobprise HB. Root planing and periodontal pocket therapy in *Blackwell's Five-Minute Veterinary Consult Clinical Companion Small Animal Dentistry*, Lobprise HB ed. Blackwell Publishing, Ames IA, 2007:61-69
4. Roudebush P, Logan E, Hale FA. Evidence-based veterinary dentistry: a systematic review of homecare for prevention of periodontal disease in dogs and cats. J Vet Dent. 2005 Mar;22(1):6-15
5. Hale FA. The owner-animal-environment triad in the treatment of canine periodontal disease. J Vet Dent. 2003 Jun;20(2):118-22
6. www.vohc.org
7. Hennet P, Servet E, Soulard Y et al. Effect of pellet food size and polyphosphates in preventing calculus accumulation in dogs. J Vet Dent 2007; 24(4):236-9

Periodontal Disease Part 2

Christopher Snyder, DVM, DAVDC, DEVDC

The foundational goal of periodontal treatment is to create an environment where the periodontal pocket can be rehabilitated to successfully return to a normal attachment depth that can be maintained. These modifications include A) making the pocket less hospitable for gram negative, anaerobic bacteria, as well as B) creating an environment conducive to reversing the periodontal attachment loss. The greatest prognostic determinant influencing the success of your periodontal treatment is the client's willingness and ability to institute homecare. Homecare products and techniques will be discussed elsewhere during a separate presentation.

Root Planing and Subgingival Curettage

Root planing is the process of cleaning a pathologic periodontal pocket on both the soft tissue (gingival side) and hard tissue (cementum) surfaces. With targeted removal of the subgingival calculus, necrotic cementum, long junctional epithelium and leaving a healthy root surface, residual periodontal ligament cells and nonkeratinized epithelium have a chance to reattach.

Instruments designed for subgingival curettage include universal subgingival curettes, Gracey subgingival curettes (these instruments have an extra angle in the working end of the instrument to facilitate debridement) and dental hoes. Subgingival curettes are the most used instruments used for this purpose when treating periodontal disease. Familiarity with the instruments is important for successfully executing treatment procedures. Curettes have a rounded toe (tip) and, when closely looking at the working surface, the cutting surface is either angled perpendicular or 70^{o} to the shank. Instruments with a cutting surface angled perpendicular to the flat surface are known as Universal curettes. When the cutting surface is angled 70^{o} to the shank, the instrument is termed a Gracey curette. Knowing the orientation of the cutting surface of your instruments is important to successfully position the instrument to accurately prepare the tooth and soft tissue surfaces.

Closed root planning is the act of *non-surgically* treating the tooth root by removing subgingival calculus, accumulated organic debris and necrotic cementum. This is reserved for treating periodontal pockets that are no deeper then 5-6mm in total depth in the canine and <2mm in the cat. The curette should be delivered into the base of the sulcus with the cutting edge parallel to the root surface until it is positioned at the bottom of the sulcus. The handle of the curette is then orientated parallel with the long axis of the tooth crown- this will engage the cutting surface onto the root surface. The active motion of the universal curette is during the pull stroke where the cutting edge engages the root surface and debrides pathologic tissues. The instrument is placed into the periodontal pocket and repeatedly drawn against the tooth structure until there is no longer any areas of resistance suggestive of subgingival calculus or diseased cementum. This should be performed on all surfaces of the root surface associated with pathologic periodontal pocket.

Subgingival curettage is the act of removing the epithelial lining of the periodontal pocket in attempt to regain healthy periodontal attachment. Once the root surfaced has been prepared, the working end of the curette should be used where the cutting edge is placed away from the root to clean the soft tissue surface of the periodontal pocket. Successful removal of long junctional epithelium is necessary for new

epithelial attachment and subsequent periodontal ligament rehabilitation. Similar atraumatic placement of the curette into the periodontal pocket is performed with an identical reorientation of the instrument handle with the tooth crown and a pull action out of the sulcus. While this does incite bleeding from the sulcus, adequate debridement is necessary to facilitate pocket healing.

Open root planing involves surgically creating a mucogingival flap that allows definitive access to the root surface needing to be cleaned. Creating this flap follows the same principles of performing surgical extractions (divergent releasing incisions, wide based flaps, etc). Flaps greater then 6mm should be surgically accessed to provide more reliable root preparation (through visualization) and soft tissue surface debridement. Vertical releasing incisions should be created along the line angles of the tooth root (as if a surgical extraction was going to be performed) to facilitate flap repositioning. A wide based flap with incisions extending from line angles provide the best opportunity for the normal forces of mastication to not undermine efforts associated with healing. When possible, vertical releasing incisions should be made over bone, in an area of healthy periodontal attachment and, ideally, on either side of an area of vertical pocketing. A sharp #15 or 10 blade should be used and the flap elevated with a sharp periosteal elevator. Periosteal elevators such as the Freer, EX9, EX7 or a straight Miller's surgical curette can all be helpful. The root surface can be debrided with a curette, hand scaler, ultrasonic scaler or diamond bur on a water-cooled, high-speed hand piece (the pedal should need to be depressed less then 50%).

Care should be taken to only remove subgingival calculus, necrotic cementum or other visualized necrotic debris. Over-preparation of the root surface risks removing unnecessary amounts of cementum, which risks stimulating external root resorption and ankylosis. Once root and flap debridement has taken place, the flap should be repositioned into the original location and sutured with 4-0 or 5-0 monofilament delayed absorbable sutures. Sutures should be placed split-thickness if releasing incisions are made over areas of periodontal attachment loss. Suture material present in the healthy sulcus or pathologic periodontal pocket will be treated as a periodontal foreign body and will cause the redevelopment of a pathologic pocket.

Periodontal pocket medicaments labeled for veterinary use are limited. Doxycycline is the most commonly used antibiotic with a carrier designed for periodontal pocket treatment. The goal of antibiotic placement into the pathologic pocket is to maintain a environment conducive (reduced load of pathologic periodontal pathogens) for periodontal ligament cell reattachment and epithelial attachment at a normal depth. The tetracycline family of drugs is frequently chosen for treatment in periodontal pockets.

While there may be anecdotal success reported for the use of emptying the contents of an oral capsule into a periodontal pocket, the periodontal-specific formulations of these medications typically involve a delayed release carrier that provides days to weeks of slow-release antibiotic activity. Doxirobe (doxycycline in a gel labeled for veterinary use) and Arestin (minocycline in a powder form labeled for use in humans) are the most common formulations used by veterinary dentists. Doxirobe is a gel (two-part carrier/doxycycline mixture) that is delivered into the periodontal pocket with an administration cannula. The mixture begins setting up once in contact with fluid (water or crevicular fluid).

Frustrations working with Doxirobe usually arise from efforts to deliver and place the gel into the periodontal pocket. Once the unset material flows out of the sulcus, efforts to knead the Doxirobe gel into the sulcus usually results in the gel sticking to placement instruments. To combat these difficulties, Doxirobe administration may require two sets of hands (help from an assistant). While one person administers the Doxirobe into the pathologic pocket, the same person can use a metal or plastic composite instrument to knead the gel back into the pocket that flows out from the free gingival margin. The second person's role is to drip water with the air-water syringe onto the tooth crown (over the Doxirobe application site, specifically). As gel flows out of the sulcus, the water and instrument cause the gel to solidify which makes it easier to reseat back into the pocket. Repeatedly kneading the gel results in securely seating the antibiotic in a predictable manner. *It is important to remember that the gel should only occupy the "pathologic" portion of the pocket. Filling the gel to the surface may result in the body treating the gel as a foreign body and reestablishment of the periodontal pocket.*

Examples can be supported in the literature stating that periodontal reattachment can occur even with the presence of residual subgingival calculus present. Diligent efforts to subgingivally condition the root surface and opposing soft tissues, coupled with compliant efforts by the client to institute home care, provide a periodontal environment that retains a potential for healing. While substantial periodontal attachment gains can occur as the result of a single treatment, it is more predictable to prepare clients for a 50% reduction in the pathologic depth of the periodontal pocket at each treatment. The deeper the periodontal pocket, the more likely that a repeated treatment may be necessary to rehabilitate the tooth's periodontal attachment. Periodontal reevaluation (ideally) should be performed in 3-4 months under general anesthesia and should involve periodontal probing and repeat radiographic reevaluation.

Guided Tissue Regeneration

Teeth are designed to be supported by the periodontal ligament (provides flexibility and reduces fracture) and alveolar bone (the anchorage point for the periodontal ligament to span to from cementum). Instances of attachment loss below the gum line, and in the presence of alveolar bone, are ideal to regain attachment resulting in that normal cementum-periodontal ligament-alveolar bone relationship with root planing and subgingival curettage. When alveolar bone has resorbed secondary to the presence of inflammation, periodontal rehabilitation of a deep pocket will likely result in establishment of long junctional epithelium attaching to the root surface. Upon recheck evaluation these teeth probe normally however the long-term prognosis of healthy attachment is less than excellent due to the tooth's inability to be adequately supported- *it wants to be supported by bone!* In these situations, performing an advanced procedure where bone is encouraged to form in addition to regenerating periodontal ligament is called *guided tissue regeneration (GTR)*. GTR is typically only successful when treating vertical boney defects. Think of it this way- osteoblasts only like to lay down new bone by migrating out of existing bone in a horizontal direction. Reversing horizontal bone loss in the mandible or maxilla is the most hotly researched topic in human dentistry because it just doesn't work. The greater the number of bony walls that a periodontal pocket has, the more surface area for osteoblasts to move in and regenerate bone. The hallmarks of guided tissue regeneration are to clean the pocket of infection and inflammatory byproducts (against the bone, in the pocket and on the root surface) and to place an osteoconductive or osteoinductive material into the pocket and cover it appropriately.

First step- Clean out the pocket! This is usually done with open root planing due to the extent of the pocketing. All debris should be removed from within the pocket and root surface, the bone should be inspected for health (it should bleed when debrided) and the epithelial lining of the soft tissue pocket wall removed via curettage.

Second step- Fill the pocket! The bony defect should be filled with something conducive to new bone formation. In rare instances with small defects a clot may be sufficient however these types of pockets are likely unappreciable on intraoral radiographs and spontaneously regenerate bone without us even knowing it. Options for filling the pocket, include autogenous bone graft, an allograft or a synthetic material (alloplast). Of the synthetics available on the market, bioactive glass which is a mixture of silicate and quartz, and has the capacity to be coated by hydroxyapatite. Whether it is some form of bone graft or an alloplast, the particulate serve as a scaffold for deposition of woven bone. While bioactive glass serves as a scaffold it takes a very long time to be completely resorbed by the body and replaced by autogenous bone. Tricalcium phosphate is an alternative for packing in boney pockets which not only serves as a scaffold but resorbs and is broken down into calcium and phosphate (both ingredients necessary for bone formation) over a span as long as 4 months. A key when filling the pocket with graft material is to only fill to the normal height of where bone should be (approximately at the cementoenamal junction).

Third step- Place a membrane! If left to heal on its own, the periodontal pocket will re-epithelialize well before new bone forms. Placement of a membrane over the bone graft particulate, abutting against the tooth, is necessary to prevent the down growth of epithelium. A variety of different membranes can be used: custom trimming a sheet of cortical bone membrane, sterile medical grade gortex, and perioceutic among others can be used to inhibit down growth. The major advantages of the cortical bone membrane or peioceutic is that removal isn't necessary since the material is ultimately bioresorbable. Following careful placement of the membrane, gingiva is sutured over it.

As stated earlier, maintaining a healthy oral cavity is pivotal to success of this procedure. A client's diligent efforts with periodontal homecare is key to creating an environment where bone regrows and periodontal ligament reestablishes. Recheck of this procedure should take place at 4 months post-treatment. Normal periodontal probing depths and radiographic reestablishment of normal alveolar bone with a visible periodontal ligament space are signs of success.

Conclusion

Early identification of periodontal disease and appropriate client selection can make for a rewarding experience when treating pathologic pockets associated with periodontal disease. Tooth preservation offers the benefit of quicker recovery than surgery, maintenance of tooth function, and improved general health from the perspective of fewer bacteria associated with intermittent bacteremia and inflammatory mediators in circulation.

Recommended reading:

1. Zetner K, Rothmueller G. Treatment of periodontal pockets with doxycycline in beagles. Vet Ther. 2002; 3(4):441-52

2. Holmstrom SE, Fitch PF, Eisner ER. Periodontal therapy and surgery in *Veterinary dental techniques for the small animal practitioner*, 3rd edition. Saunders, Philadelphia PA, 2004:233-43

3. Lobprise HB. Root planing and periodontal pocket therapy in *Blackwell's Five-Minute Veterinary Consult Clinical Companion Small Animal Dentistry*, Lobprise HB ed. Blackwell Publishing, Ames IA, 2007:61-69

4. Alterman B, Huff JF. "Guided Tissue Regeneration in Four Teeth Using a Liquid Polymer Membrane: A Case Series." *Journal of Veterinary Dentistry* 2016;33(3):185-194.

Regional Anesthesia Techniques for Dental Patients

Christopher J. Snyder, DVM, DAVDC, DEVDC

Overview of the Issue

Regional anesthesia and pain management are fundamentally important skills to successfully leverage for the benefit of our dentistry and oral surgery patients. Despite these patients being under general anesthesia while undergoing procedures, there are inherent benefits to practicing techniques that will allow for the reduction of inhalant anesthesia, improve recovery and improve the patient's comfort at the time of discharge. Anatomy of the face and mouth is complex. There are many locations and combination of locations where local anesthetics can be administered which will result in regional anesthesia. Through the use of anatomic cues, we continue to better understand the signs of oral pain in cats.

Key Etiologic and Pathophysiologic Points

Regional anesthesia can offer many benefits by reducing the animal's response to painful stimuli during the procedure as well as provide postoperative analgesia. Primarily speaking, benzodiazapines, phenothiazines and general anesthetics have no primary analgesic activity. These medications alter the state of consciousness and abolish the perception of pain. Peripheral sensitization, or a reduction in the threshold necessary for stimulus transduction occurs due to the effects of tissue injury and inflammation. Inflammatory mediators including prostaglandin E2, bradykinin, neurotrophic factors (NGF) and the activation of mast cells contribute to peripheral sensitization. These inflammatory mediators lower the activation threshold and increase the amount of Na+ flowing across the channel. Once the general anesthetic medications are metabolized, the patient is vulnerable to the sensation of pain.

Local anesthetics work by inhibiting transmission through their effects on Na+ channels. By preventing depolarization and propagation of neural signals to the brain, pain can be effectively blocked. While local blocks reduce the amount of perceived pain and amount of required general anesthesia and associated unwanted side effects, the patient's comfort can be improved. Effective local blocks are not a replacement for safe, effective general anesthesia. The addition of local blocks to the anesthesia and analgesia protocol will provide the benefits of polypharmacy which can be recognized as threefold. These drugs: (1) prevent peripheral and central sensitization, (2) reduce the adverse effects associated with larger doses of medication and (3) provide better postoperative pain management to smooth out the recovery of the patient.

Studies measuring minimum alveolar concentration have shown that administration of local anesthetics reduce the amount of inhalant necessary to keep 50% of patients asleep during a given stimulus. The use of local anesthetics preventing the propagation of nerve impulses may be beneficial on its own but may be further improved through the addition of opioids or alpha2 agonists administered locally.

When given as a local anesthetic, the lidocaine family of drugs provides a variety of options with different onsets of action and different durations of action. Doses should not exceed 5mg/kg in dogs and 2mg/kg in cats. Lidocaine is commonly used in human regional and local anesthesia because a quick onset and short duration of action is desirable. Compliance with human patients for taking oral medications is quite good and return to function (frequently the workplace) is important. In canine and feline dentistry, bupivacaine is a popular medication used off label because of its longer duration of action. Depending on

placement the duration of action may be 6 to 10 hours. Recent study information suggests that duration of action may vary by individual dog, but that bupivacaine may last 1-3 days. Time to onset of action is longer with bupivacaine than lidocaine, some texts referring to a 20-minute period necessary before the nerve impulses are effectively blocked. Lidocaine is labeled for veterinary use while bupivacaine does not carry that label for veterinary use. The most common concentration of bupivacaine is 0.5% (5mg/mL) while lidocaine is 2% (20mg/mL). Mixing these drugs should be discouraged until substantiated research is preformed determining that the drug remains active and what the concentration of active drug is. A recent publication demonstrated that mixing lidocaine and bupivacaine worked longer than lidocaine alone. That study's results with bupivacaine mixed with lidocaine demonstrated a shorter duration of action than a study using bupivacaine alone. This begs the question whether mixing the two drugs results in a reduction in the prolonged effect of bupivacaine alone.

Key Clinical Diagnostic Points

Using the techniques covered in this presentation, it has been the experience of the author that small dosages are sufficient to achieve the desired result of local blockade. Using the techniques discussed, the entire mouth can be anesthetized through the administration of local anesthetic in only four locations.

Bupivacaine
0.1-0.15mL per site (cat or small dog)
0.2mL per site (medium dog)
0.3mL per site (large dog)

The various blocking locations are listed below.

Infraorbital Block

Location: immediately within the infraorbital canal
What it blocks: maxillary incisors, canine tooth, premolars 1-2, +/- 3, buccal mucosa, ipsilateral lip, ipsilateral soft tissue of that side of the face
What it won't block: palatal mucosa, PM4 (commonly extracted), may not completely anesthetize for extraction of the central incisors due to crossover innervation

Caudal Maxillary Block

Location: advance the needle parallel with the hard palate trough the infraorbital canal to approximately half the length of the most lateral surface of the zygomatic arch
What it blocks: all the maxillary teeth in that quadrant, ipsilateral lip, ipsilateral hard/soft palatal mucosa, ipsilateral soft tissues on that side of the face
What it won't block: may not completely anesthetize the central incisors

Middle Mental Block

Location: ventral to the mesial root of the 2nd premolar (dog). Enter in through the mesial aspect of the labial frenulum and place the needle against periosteum half the height of the mandible and centered over the tip of mesial root of the second premolar
What it blocks: ipsilateral lip and rostral soft tissues, incisors? and canine tooth?

What it won't block: Questionable coverage for the ipsilateral mandibular incisors and canine tooth (probably due to diffusion into the mandibular canal)

Caudal Mandibular Block (Inferior Alveolar Block)

Location: two main approaches

1. Intraoral: half the distance between the angular process and the mucosa immediately caudal to the third molar (lingual side of the mandible)
2. Extraoral: palpate the ventral notch of the mandible, half the distance of the length of the notch, place needle perpendicular to the notch and immediately on the lingual surface, advance needle ½ to 1 cm

What it blocks: all ipsilateral mandibular teeth, rostral mandibular soft tissues

What it won't block: questionable coverage for caudal mandibular soft tissues, if applied correctly, should not risk anesthetizing the tissues of the tongue

Note: *It has been shown that intraoral administration of the caudal mandibular block is more accurate than the extraoral approach- this may be useful in helping to reduce the risk of inadvertent blocking of the sensory innervation to the tongue.*

Once the needle has been placed, it is important to aspirate, and re-aspirate, while rotating the needle 90^{o} along its long axis to ensure the injection is not given intravascular. Medication should be administered with the needle being placed on periosteum for the middle mental, and caudal mandibular blocks. Even if the bevel is not directly over the nerve, by being deposited on periosteum, the local will cover more surface area and increase the chance that the nerve will be coated. Once the local has been administered, the needle should be withdrawn and digital pressure should be placed for 1 minute to provide adequate time to prevent hematoma formation.

Prolonging the Anesthetic Effects with Opioids

There is reasonable expectation that the addition of opioids to a local block may improve postoperative analgesia long after the effects of the sodium channel blockade wear off. In a study performed in dogs comparing bupivacaine versus bupivacaine + buprenorphine (15mcg) it was shown that 3 of 8 dogs with the combination demonstrated analgesia 72-hours post administration while 2 of 8 dogs experienced analgesia 5 days following administration. It has been well established that *mu* receptors exist in the peripheral nervous system and are up-regulated when exposed to chronic noxious stimulation. Dentistry patients undergoing procedures for acute injuries, such as tooth fracture, are less likely to demonstrate the benefits of opioids in their local blocks as compared to cats with stomatitis or tooth resorption. Chronic conditions may make some drugs work better or last longer.

There are several situations where long-term desensitization of a surgery site may be undesirable. Patients suffering from an oronasal fistula already have a loss of bone and a communication between the oral and nasal cavities. Repairing these defects and having the surgery site be completely numb may result in the animal becoming preoccupied with feeling the sutures on their tongue and subsequently tongue thrusting through the surgery site up into their nasal cavity. Similar potential situations exist with maxillectomy patients. It is this author's experience and recommendation that using short acting local anesthetics like lidocaine followed by aggressive post-operative pain management will result in a comfortable patient after surgery with decreased risk of tongue thrusting. Procedures involving the tongue should never receive

local block administration because these patients will be at very high risk of self-trauma and risk "chewing their tongue off." Use of large volumes when performing local blocks has also been anecdotally reported in resulting in this form of self-mutilation. Sticking with the small volumes and accurate placement afford good results with decreased risk.

Whenever there is potential for the local block needle to traverse through an area of possible tumor, the local block should not be performed. Seeding tumor cells through the infraorbital canal may extremely complicate treatment options available for a maxillary tumor. Using a 25 gauge 1 inch to 27 gauge 1.5-inch needle helps reduce possible nerve injury.

Complications

Complications with local anesthetic blocks have been reported in the literature. Paraesthesia, altered sensation and motor changes are occasionally reported anecdotally from practitioners. It is unclear as to where the origin of nerve injury associated with local anesthesia comes from. While histologic nerve changes associated with local anesthetic administration are reported in veterinary patients (Correspondence: J Anthony), true clinical significance should be considered since similar blocks have been performed in humans for decades with a low incidence of true complications. Peripheral nerve paraesthesia is a rare complication reported in humans. One human dental textbook reports an occurrence of 1 case in 1 million injections. Peripheral nerve paraesthesia and subsequent self-mutilation of the veterinary patients' tongue has been only anecdotally reported. The technique for proper needle placement for local anesthetic placement is different than it is for venipuncture. After initial needle penetration, the needle should be guided into position for local administration. When these needles are guided through foramen (as in the infraorbital or caudal maxillary blocks) the needle should be advanced slowly and in most situations the needle bevel with help to displace the neurovascular bundle as the bevel is advanced. Nerves penetrated by needle placement can have variable effects- from no change to permanent sensory or motor dysfunction.

There is a school of thought that nerve injury associated with local blocks may not be directly related to physical damage by needle placement. Peripheral nerve ischemia associated with the addition of epinephrine to a local block may also be associated with nerve injury. The addition of epinephrine to long acting local blocks has therefore been recommended against for that very reason. Beyond the delayed absorption of local anesthetics by the vasoconstriction associated with epinephrine, it has been shown that this catecholamine has some alpha-2 agonist analgesic activity.

The use of small doses in regional anesthesia and aspiration immediately after needle placement can help avoid inadvertent intravascular injection. The most common complications with intravascular injections of local anesthetics include seizures and cardiac toxicity. Bupivacaine has a high affinity for cardiac sodium channels and can cause brady-dysrhythmias as well as ventricular tachycardia and ventricular fibrillation in humans.

The complications of inadvertent anesthesia of the tongue and iatrogenic globe penetration with the needle while performing the maxillary nerve block should both be effectively prevented by close attention to careful needle placement. Iatrogenic perforation of the globe by a needle during local anesthetic placement has a high mortality rate to the eye.

SUMMARY

Effective local blocks are not a replacement for safe, effective general anesthesia or multimodal postoperative pain management. Use of local anesthetic agents helps to reduce the amount of inhalant general anesthesia required to keep a veterinary patient anesthetized. The unwanted, most frequently seen complications associated with general anesthesia in veterinary patients who are anesthetized for any reason are hypotension, cardiac dysrhythmias, hypercapnea and hypoxemia. Multimodal analgesia anesthesia can help reduce these unwanted side effects by reducing the amount of gas required to keep the patient anesthetized.

References/Suggested Reading

1. Lamont LA. Multimodal pain management in veterinary medicine: the physiologic basis of pharmacologic therapies. Vet Clin North Am Small Anim Pract 2008 Nov; 38(6):1173-1186
2. Beckman BW. Pathophysiology and management of surgical and chronic oral pain in dogs and cats. J Vet Dent 2006 Mar; 23(1):50-60
3. Snyder LBC, Snyder CJ, Hetzel S. Effects of buprenorphine added to bupivacaine infraorbital nerve blocks on isoflurane minimum alveolar concentration using a model for acute dental/oral surgical pain in dogs. J Vet Dent. 2016;33(2):90-96.
4. Snyder CJ, Snyder LBC. Effect of mepivacaine in an infraorbital nerve block on minimum alveolar concentration of isoflurane in clinically normal anesthetized dogs undergoing a modified form of dental dolorimetry. J Am Vet Med Assoc. 2013;242(2):199-204.
5. Gaynor JS, et al. Complications and mortality associated with anesthesia in dogs and cats. J Am Anim Hosp Assoc 1999; 35:13-17
6. Goudie-DeAngelis EM, Snyder CJ, Raffe MR, David FH. A pilot study comparing the accuracy of two approaches to the inferior alveolar nerve block in canine cadavers. Intern J Appl Res Vet Med 2016;14(1):49-58
7. Perry R, Moore D, Scurrell E. Globe penetration in a cat following maxillary nerve block for dental surgery. J Feline Med Surg 2015;17(1):66-72
8. Pascoe, Peter J. "The effects of lidocaine or a lidocaine-bupivacaine mixture administered into the infraorbital canal in dogs." *American journal of veterinary research* 77.7 (2016): 682-687.
9. Steagall PV, Monteiro BP. Acute pain in cats: recent advances in clinical assessment. J Feline Med Surg 2019; 21:25–34.

Extraction Techniques and Avoiding Complications

Christopher J. Snyder, DVM, DAVDC, DEVDC

A multitude of clinical scenarios arise daily leading to a veterinarian's recommendation for treatment. While a variety of advanced treatments may exist for different forms of dental pathology, limitations such as client willingness to pursue advanced treatment or a veterinarian's comfort with performing the procedure may shorten that treatment list. Confidently identifying oral lesions in dogs and cats can be complicated and sometimes tricky. The use of information provided by dental radiographs is key to appropriate treatment planning and sometimes even identifying lesions below the gum line which is especially important when identifying resorptive lesions in cats.

Extraction of teeth, although not necessarily always the best option to treat diseased teeth, frequently offers a predictable treatment for painful conditions. While your confidence and efficiency in performing extractions will improve with practice, be cognizant of always offering the client *all* the treatment options, even if referral is necessary

Avoiding Complications

Clinical and teaching experience solidifies my belief that extraction complications begin and end with issues associated with adequate *visualization*. Appropriately visualizing teeth for extraction begins with intraoral radiographs to assess health of neighboring bone, presence of ankylosis, and abnormal shapes. Dental radiographs allow you to anticipate challenges while performing the extraction but visualizing the surgical site can be a different 'beast.' Adequate flap creation, surgical suction, magnification, and adequate surgical lighting all improve one's ability to discern the tooth-to-bone interface during bone removal. In my experience, challenges with extractions can be overcome by leveraging the aforementioned techniques to better visualize where instruments are being placed and tissues being altered.

Extraction Armamentarium

Having the right instruments can make the difference between an extraction going smoothly or taking all day. Luxators are made of soft metal designed to be kept very sharp and are used by placing them into the sulcus between the periodontal ligament (PDL) space and alveolar bone. Luxators function as a "wedge" between the PDL and alveolar bone and applying a force for 15-20 seconds. PDL fibers are designed to withstand acute compressive and tipping forces but will stretch and sever with long persistent forces. The luxator is then repositioned and the same action is performed at other locations around the tooth. Dental elevators, being made of a stronger alloy, allow for applying leveraging forces while anchoring off adjacent healthy teeth or neighboring bone. Elevators can also apply rotational forces in a manner where leverage is placed against the target tooth in effort to apply "lifting" forces out of the alveolus. Remember, whenever leveraging against a neighboring tooth, whichever tooth has the smaller, healthy root mass will be the one that moves.

Any instruments used in oral surgery to create a force along the long axis of the instrument (luxators, elevators, periosteal elevators) should all be held using the *short stop grip*. Placing the instrument in the palm of your hand and strategically extending your finger along the shaft towards the working end creates a bumper (your finger) to minimize trauma should the

instrument slip. This is particularly important when working on maxillary extractions since penetration into the nasal cavity, periorbital space or through the calvarium could all lead to significant complications.

After elevation, the extraction site should be closed with absorbable suture. There should be absolutely no tension on the suture line before closure. Sutures like chromic gut are appropriate for patients who will heal quickly (juvenile patients) but may not be ideal for patients where delayed healing is expected. Delayed absorbable sutures are better at withstanding the constant activity of the oral cavity. Whichever suture is used, 5 to 6 suture throws are recommended with knots spaced every 2-3mm.

Extraction Techniques: Closed (Nonsurgical)

A closed extraction technique involves not needing to create incisions into epithelium or section teeth into individual roots. This technique is typically only applicable to incisors or extremely diseased multi-rooted teeth. The divergent nature of dogs' and cats' multi-rooted teeth usually precludes them from being removed through simple elevation. Elevation frequently can be achieved with luxators to fatigue and break down the periodontal ligament as well as dental elevators placed in the periodontal ligament space and rotated or tipped to fatigue the periodontal ligament fibers. Any forces applied and designed to break down the periodontal ligament fibers should be applied for 15-20 seconds to allow for fiber rupture and hemorrhage which will further break down fibrous attachment. After the tooth or tooth roots are removed, the alveolus should be inspected for residual signs of granuloma, infection, root remnants or bone spicules. All these residual tissues should be cleared away. Sharp bony edges should be blunted with a diamond bur on a water-cooled high-speed hand piece before closing the extraction site. Edges of the gingival collar should be scarified with a surgical blade or with a high-speed diamond bur. If wound edges are unable to be closed, use a periosteal elevator to create a mucoperiosteal release extending beyond the mucogingival line of the soft tissues. This will take advantage of the elasticity of mucosa.

Extraction Techniques: Open (Surgical)

Typically, the idea of surgical extraction is associated with the creation of a mucoperiosteal flap. Principles of flap creation include:

- Flaps should have divergent vertical releasing incisions. A wide based flap allows for better maintenance of blood supply as well as flexibility for the flap to cover wide voids when being advanced. This is important to minimize creating tension!
- Incision lines should be made over *line angles*. Line angles are where "faces" or surfaces of the tooth come together. These intersections of the faces of teeth are surfaces where food would naturally be deflected away from the incision line. Faces of each tooth are found between the buccal, lingual/palatal, and mesial and distal surfaces.
- Incisions should be made, and closed over, areas supported by bone. Err on the side of making incisions wider than necessary to ensure that suture lines are supported and flaps maintain healthy vascularity.
- Vertical releasing incisions should extend past the mucogingival line. Gaining stretch in the flap occurs from the elastin content found in mucosa. The flap is elevated with a periosteal elevator. Attached gingival fibers are oriented in a way to resist forces in

a coronal-to-apical direction. Elevating the flap in an apical-to-coronal direction may serve to make flap elevation easier.

- Sectioning of teeth should occur after buccal cortical bone is removed and the furcation can be visualized. Being able to see the furcation and section the tooth from the furcation towards the oral cavity prevents sectioning the tooth and inadvertent cutting into root structure.
- When removing buccal cortical bone or inspecting for tooth roots, remember that cementum and dentin do not bleed. Much of the difficulty with isolating fractured roots or inspecting the alveolus for debris results from problems with visualization. Suction, a good light source and magnification if possible all permit the surgeon to visualize for bleeding structures while identifying and elevating structures that aren't bleeding.
- Rarely should crown amputation be necessary in canine patients. While indications exist for this to occur in cats, dogs rarely exhibit ankylosis and the replacement root resorption necessary to consider crown amputation. Instances where extractions need to be cut short due to anesthetic complications or if surgically exploring for a fractured root tip is beginning to cause more harm than good, closing the extraction site and moving on is recommended. The client should be made aware of the situation and the patient should be radiographically evaluated in 6 and 12 months to evaluate the residual fragment for signs of infection (periapical radiolucency).
- After removing the buccal cortical bone and sectioning teeth, the use of very small cutting bur may be helpful to outline and create a trough in the periodontal ligament space. This enables easier placement of dental elevators and may be particularly necessary in patients who have evidence of ankylosis.
- In some situations, cutting the crown off the tooth will facilitate easier elevation.
- Dental crowding or the close association between adjacent teeth may make placement of luxators or elevators difficult. Selective removal of parts of the crown of the tooth being extracted may be helpful in creating space for the instruments to generate leverage during extraction. These kerfs may be a big time saver when maxillary PM4 distal roots are closely associated with the M1 or when the mandibular PM4 is in close association with the M1.

Complications

In instances of maxillary canine tooth extraction, an oronasal fistula may be discovered or inadvertently created during extraction. These patients demonstrate postoperative blood-tinged nasal discharge and the importance of a tension-free, airtight closure is extremely important. Sneezing when eating or drinking is a sign of complications during healing. If dehiscence occurs, wound edges should be allowed to heal completely before attempting a revision. A poor to grave prognosis is given with perforation of the globe or braincase and the patient should be immediately referred. Mandibular fractures are typically associated with severely diseased teeth and usually occur during extraction of the canine teeth or first molars. Support both sides of the mandible during canine tooth extraction. Iatrogenic fractures are much more easily fixed than pathologic fractures.

Conclusion

There are many indications for dental extractions. Practitioners should do everything possible to thoroughly identify disease, offer appropriate treatment options and perform extractions safely.

Recommended Reading:

1. Blackwell's Five-Minute Veterinary Consult Clinical Companion Small Animal Dentistry. 2007 Author: Heidi Lobprise.
2. Gengler WR. Exodontics: extraction of teeth in the dog and cat. *Vet Clin North Am Small Anim Pract* 2013;43(3):573-85
3. Carmichael DT. Surgical extraction of the maxillary fourth premolar tooth in the dog. *J Vet Dent.* 2002 Dec;19(4):231-3.
4. Fitch PF. Surgical extraction of the maxillary canine tooth. *J Vet Dent.* 2003 Mar;20(1):55-8.
5. Marretta SM. Surgical extraction of the mandibular first molar tooth in the dog. *J Vet Dent.* 2002 Mar;19(1):46-50.

Maxillofacial Growth and Mandibular Fracture Repair

Christopher Snyder, DVM, DAVDC, DEVDC

The successful use of intraoral splints using provisional composite resin or acrylic has been described repeatedly in the literature for the successful treatment of maxillary and mandibular fractures. Both light cured and self-curing composites can be used. While the strength of the different materials has not been assessed in vivo, certain product materials may have increased strengths over others. Popular materials include self-curing provisional crown and bridge material that have been anecdotally acknowledged to have a volume-dependent exothermic chemical reaction associated with curing. Recognizing that heat is produced becomes important when considering a potential risk for causing thermal pulpitis.

Skeletal Growth in Dogs and Cats

When developing structures originate in the form of cartilage and the layers of chondrocytes become so thick that the external nourishment cannot take place, reorganization occurs, and an internal blood supply develops. When this develops, these areas become centers of ossification where cartilage becomes ossified (endochondral ossification). Endochondral ossification represents how the canine and feline chondrocranium forms. The cranial vault and maxilla and mandible form by intramembranous ossification where bone matrix is directly secreted by connective tissues. Continued osteoblastic differentiation in the periosteum and endosteum result in additional bone deposition.

Regulation of maxillofacial growth is a dynamic process impacted by hormones, genetics and the active forces of the teeth and muscles of mastication. Growth of the mandible is not controlled by the condyle. Muscular attachment and forces acting on the TMJ impact growth. Forces placed on the TMJ restricts growth while lack of forces encourage mandibular growth. In addition, the lips play a role on the centripetal pressure on the dental arches while the tongue plays an equivalent and opposite force. An abnormal balance between these two forces can result in growth abnormalities. This can be particularly evident in children who have suffered craniofacial injuries that result in developmental abnormalities. Dogs and cats having a profound dental interlock (relationship between mandibular canine teeth and maxillary third incisors and canine teeth) help coordinate maxillary and mandibular growth.

In genetic studies in the 1930's, deliberate cross breeding between skull shapes revealed that as dogs were selectively bred to have brachycephalic head shapes from mesocephalic head shapes, the muzzle length became shorter without a proportional change in tooth size. This caused rotation, crowding and changes in occlusion. These genetic studies showed that tooth form/shape was the most stable characteristic of the dog skull. Genetics were shown to independently control the maxilla and mandible, and independently control tooth size from the maxilla and mandible. Cephalometric studies in dogs have shown that the maxilla and mandible were independent in size and that the size of the dental arch demonstrated larger variation in size than did the size of teeth.

Three theories exist for control of craniofacial development. Maxillofacial growth potential is thought to be controlled by: the actual bone, the cartilage or the immediately surrounding soft tissue structures. While cartilage and immediately surrounding soft tissues seem to be the most plausible determinants of growth, it is accepted that the functional demands on the bone in combination with the soft tissues control development.

Cartilages that give rise to development of the mouth are the palatoquadrate cartilage giving rise to the maxilla and Meckel's cartilage forming the mandible. Most of the mandible forms from intramembranous bone formed within the soft tissues adjacent to the cartilage. Maxilla and mandible both develop by intramembranous ossification. The maxilla grows by appositional bone growth at the attachment of the maxilla to the cranium and by surface remodeling. Mandibular bone forms by intramembranous, interstitial and appositional bone growth. Mandible grows by endochondral ossification at the mandibular condyle and appositional growth stemming from the periosteum surfaces.

A majority of mandibular growth occurs from bone growth along the caudal aspect. Supporting evidence that growth occurs entirely from growth of the caudal mandible is supported by one study that evaluated the incisor to mandibular first molar distance and found no change in distance between 3 and 6 months of age. Studies in mice using radiolabels attached to developing dental tissue demonstrated that the location of caudal cheek teeth extended almost completely to the caudal edge of the developing mandible. Through simultaneous appositional bone growth and resorption, those tooth structures continued development and eruption into what forms the caudal mandibular body. In dogs it is believed that growth almost exclusively originates from the caudal mandible starting at day 50.

The mandible gains height through cartilage replacement at the condylar process and bone deposition along the ventral border of the caudal mandible. Mandibular height increases through appositional bone growth along the ventral border and alveolar crest at the time of tooth eruption. The reality of mandibular growth is not that it grows down and away from the base of the skull but instead pushes upward and caudally against the TMJ resulting in translation. Mandibular bone growth has shown to be rapid early in skeletal growth but by 6-7 months of age the mandible appears to be relatively unchanged thereafter. This correlates with the cephalocaudal gradient of growth proposed in humans where it is believed that the closer to the calvarium a bone is, the less growth potential it has.

Growth of the nasomaxillary complex is believed to occur by two mechanisms- natural growth by the calvarium resulting in forward displacement of the maxilla, and appositional growth at the suture lines stimulated by the surrounding soft tissue. The maxillary sutures responsible for growth are the incisivo-maxillary suture line and the palato-maxillary suture line. The palato-maxillary suture line plays an active role in growth early in development, but its contribution diminishes with age while the contribution of the incisivo-maxillary suture increases. After eruption of the permanent teeth any remaining growth of the maxilla originates from the incisivo-maxillary suture

line. Increase in the maxillary width occurs at the intermaxillary suture line and is relatively unchanged after 22 weeks of age.

Measurements and tracking of developing tooth germ have also been studied in dogs. Additional evidence that the teeth are disproportionately large in smaller dogs has been shown in the tooth to arch ratio. This ratio has been shown to be higher in small dogs predisposing them to crowding. In general, through development and growth, this ratio is higher early on and decreases during development. This explains why some dogs may demonstrate crowding at a very young age and seem to "grow" out of it.

Occlusal forces have also been shown to impact mandibular and maxillary bone growth. In two dogs it has been shown that extracting teeth during development impacted ipsilateral mandibular bone height and underdevelopment of the condyle. No studies with large groups of dogs have been done nor do specific measurements exist, but there does appear to be reasonable support to suggest that occlusion impacts alveolar bone development and how occlusion impacts jaw growth. The degree of muscle activity is confirmed to be highest in areas of attachment of the most powerful muscles. And muscle activity is the greatest extrinsic factor affecting jaw length development.

Proper Tooth Preparation

Maxillomandibular fixation (MMF) can serve as a useful mechanism for restoring oral fracture patients to normal occlusion. By returning the patient into normal occlusion, fracture fragments should be reduced to a functional apposition resulting in the maintenance of that occlusion after healing. Use of a loose fitting muzzle may be the least expensive form of MMF. This option relies on tooth structures to guide the lower jaw into a functional, atraumatic position. The instability of fracture fragments with this form of MMF risks exuberant callus formation, nonunion or fibrous union. A more stable form of reduction includes temporary fixation of the maxillomandibular relationship using bonding materials to immobilize the mandibular and maxillary canine teeth. MMF using this technique is designed to approximate the fracture fragments into an orientation that will leave the patient functional after healing, as well as to reduce micromotion enough to reduce the size of callus formation. The canine cusp tips are closely approximated leaving 1cm of space between the incisors – this should be enough space for the animal to be able to lap water and liquid food. Immobilization should not exceed 3-5 weeks without reinstituting some sort of physical therapy in order to prevent functional ankylosis from developing due to restricted motion of the TMJ. MMF may be most appropriate for fractures that are already reduced or stabilized by surrounding soft tissues. Specific fractures that may be most appropriate for MMF include: stable and nondisplaced fractures, fractures of the ramus and condylar neck fractures. It is in my opinion that if pain could be reasonably managed, it is appropriate to consider using MMF when finances are an issue and euthanasia is the only other option. Clients must be aware that MMF carries a greater risk of complications with healing compared to more semi-rigid or rigid forms of fixation.

Using dental composites to place a patient into MMF should be done with several major considerations in mind. Firstly, consideration should be made to avoid the risk of developing false ankylosis due to the restrictions on TMJ motion. Limiting the range of

motion of the TMJ for 3, to no more than 5 weeks should reduce the chances of ankylosis. Depending on the location of the fracture, extent of the injury, and age of the patient, the patient may need to graduate out of composite fixation and into a loose fitting muzzle to maintain occlusion and provide supplemental support.

Consideration should also be given to follow-up anesthesia episodes. Different techniques can be implemented to aid in the removal or breakdown of composite for anesthesia. Creating scores in the composite or superficially marking the composite between the tooth cusps at the time of placement can facilitate easier scoring and breaking the MMF. Haphazard or hasty removal of composite can result in iatrogenic enamel damage. It would be wise to include unintended tooth damage as a potential complication when counseling clients. Otherwise, anesthetic induction is followed by immediate severing of the composite bridges and endotracheal intubation. An alternative may be to endoscopically intubate the patient. Once intubated and stable, additional composite can be removed from the tooth crowns by creating longitudinal scores in the composite and using calculus removal forceps to free the composite from the tooth surface. By acid etching and applying adhesive to select areas of the crown rather than the entire crown, composite removal may be easier. Be warned, decreased adhesive surface area results in decreased adhesion!

Tooth Conditioning

Four important properties necessary for dental adhesives are: wetting, interpenetration, micromechanical interlocking and chemical bonding. Wetting is the property of a material to contact another material and spread across its surface. Enamel and dentin are hydrated tissue structures, which are hydrophilic and therefore require a resin material that is also hydrophilic. These bonding materials create a “hybrid” layer by coating the enamel or dentin and upon curing, creating a hydrophobic surface conducive to the wettability and adhesion of hydrophobic materials (composites).

Acid etching is an effective way of enhancing mechanical bonding. Etching has expanded the use of resin based restorative materials because of the strong bond created between resin and enamel. Without improvements and advancements in bonding, composite materials would not be able to resist leakage of fluid at the tooth-composite interface, which undermines bond strength. Etching enamel surface increases microporosities and roughness which increases surface energy- a quality describing the interaction between the resin material’s affinity to spread across and interdigitate into those microporosities. An etched surface enables resin to flow into surface microporosities and form 10-20um resin tags. 37% phosphoric acid is used most commonly with concentrations greater than 50% generating a layer of monocalcium debris on the tissue surface inhibiting dissolution. It is important to avoid the creation of bubbles on the enamel surface when etching since those surfaces will not be etched. Most teeth should only undergo 15 seconds of etching time followed by 20 seconds of thorough rinsing. The tooth surface is then air-dried and should appear white and frosty. It is important to maintain a dry tooth surface after etching until the adhesive is applied. Brief contact with blood or saliva will greatly reduce surface energy of the roughened enamel and significantly reduce the resin’s ability to wet (spread across) the surface. Oil

from the air/water syringe can also contaminate the etched surface. If contamination is suspected, debris should be removed and the surface re-etched for 10 seconds.

Historically, bonding agents were specific to enamel. Advances in chemical engineering modified these agents to be less hydrophobic and better able to wet the surface of dentin. These materials are used today because of their added advantage to bond to both enamel and dentin. Dentin bonding products were developed to combat the increased organic component and water contained in dentin. These products showed universal ability to bond to acid etched enamel and dentin surfaces. The key to the success of these products was the development of materials that contained hydrophilic monomers capable of flowing and interdigitating with the collagen tags while also containing hydrophobic monomers that would move away from the treated tooth surface. This facilitates the bonding agent's ability to chemically adhere with the hydrophobic composite matrix. These bonding agents are described in generations with the earliest being least effective. It is important to understand which system you are using to ensure that the proper steps are taken to condition the tooth surface to maintain a proper bond.

First and second-generation adhesives: These materials used silane coupling agents to bond inorganic filler to the resin matrix in composites. Further iterations included modifications to better bond to dentin. Neither of these generations of material was clinically successful.

Third generation adhesives: These materials included an acid designed to react with Ca^{2+} ions and reduce interaction with the smear layer. These products required 4 steps involving: a conditioner (acid), a primer, an adhesive and resin composite.

Fourth generation adhesives: There was a shift away from fears that etching dentin was detrimental to the pulp. This was the underlying reason for changes in chemicals used in this generation of adhesives. Tooth surface is etched and rinsed in this system but the conditioned surface is not desiccated for fear of the exposed collagen mesh would slump and result in difficulty of the primer infiltrating the collagen surface. This generation of products required etching, rinsing, drying, moistening, slightly drying, applying a primer, drying thoroughly, adhesive application and light curing, composite application and light curing. These products were the first to introduce the total etch principles (to both enamel and dentin) followed by rehydrating the dentinal collagen and the "wet" bonding process.

Fifth generation adhesives: This generation of materials attempted to reduce the number of steps in fourth generation products with the hope there would be less room for technical human error. Products which combine the conditioner and primer (self-etching primer) or combining the primer and adhesive (self-priming adhesive) were introduced. Proposed products that include all components (self-etching/priming/adhesive) in one solution are being researched and would be considered sixth generation systems. Early indications show that there may be potential for sufficient bond strength to dentin but not enamel.

Composites

Materials containing inert filler particles (quartz powder) reduce curing contraction by taking up space and not participating in the setting reaction. It is important that these filler particles create bonds to the polymer resin to maintain structural strength.

Composites contain a resin matrix, inorganic filler materials and a coupling agent. An activator-inhibitor mixture is necessary to take a semi-liquid, moldable material and transform it into a hardened material. Of the resin matrix components in composites, bisphenol A glycidyl methacrylate (bis-GMA), triethylene glycol dimethacrylate (TEGDMA) and urethane dimethacrylate (UDMA) are the most prevalent ingredients used today. Before activation and polymerization, monomers are weakly held together by van der Waal forces. Once polymerization occurs, covalent bonds tightly bond the monomers. In light curing systems, polymerization of the monomers occurs with the material closest to the light activator condensing and polymerizing first. Shrinkage of material therefore occurs towards the light source. Multiple particle sizes are used in most dental composites to maximize the amount of filler into a resin matrix. Quartz is commonly used filler that adds great strength to dental composites.

Polymerization occurs by a series of chemical reactions where monomers (small molecules) are bonded to form one large polymer (macromolecule). A benefit of polymers is that their size can almost become limitless and forms a structure that is cross linked and of variable chain length. Addition polymerization is the chemical reaction whereby monomers join onto the end of chain to form a polymer.

Chemical cure systems are formed by the mixing of two pastes. When the pastes are mixed an initiator and amine activator to form free radicals, which initiate additive polymerization. Light cure composites rely on visible blue light activated system. In these systems, a photosensitizer and amine initiator are included in one paste. When exposed to the blue light spectrum of light (460-480nm), the photosensitizer reacts with the amine to generate free radicals in turn resulting in addition polymerization. Camphorquinone is a commonly used photosensitizer. Inhibitors may be added to composite resins to prevent spontaneous chain polymerization. If free radicals are formed and absorbed by the inhibitor, polymerization stops. If the inhibitor is used up or destroyed in a curing process, addition polymerization continues.

Chemical activation of composites is referred to as cold-cure or self-cure composites. The operator has no effect on curing time once mixing of the pastes occurs. The depth of cure for light cure composites is restricted based on light penetration. Curing (exposure to the blue light should occur in 2mm thick increments and be exposed to the light for 40 seconds or less depending on manufacture's recommendations). Light curing lamps (light guns) emit a light source within the 460-480nm wavelength spectrum. Curing lamps are being developed with increasing intensities that results in certain curing lamps generating shorter necessary curing times and the capacity to cure to greater depths. Due to dissipation of photons at greater depths, insufficient photo activation may occur at depths greater than 3mm at a recommended exposure time- greater exposure times may be necessary which offsets the advantages of photo curing shallower depths more quickly.

As composite material cures (light cure or chemical cure) a layer remains on the surface known as the oxygen inhibiting layer. In the presence of oxygen, composite is monomers and resin matrix is unable to polymerize. Layering additional composite onto this surface provides an ideal surface for continued polymerization of the unit. Even after polishing or material removal, additional composite can be added and cured. Over time, fewer and fewer unreacted methacrylate groups remain and the potential for cross-linking and addition of new monomers to penetrate into the matrix decreases. Composite segments that fracture well after initial curing can be reapplied with a bonding agent and composite reapplied. The bond strength between this new composite and the cured composite should be viewed as having less than half the original composite's strength. In one study evaluating light curable composites compared to chemical cure composites for bonding of canine teeth in cats, it was found that light cure composites were stronger than chemical cure. Additionally, light cure composite resins took longer to remove and were associated with a greater number of complications associated with removal.

Maxillomandibular Fixation (MMF) Application and Removal

Once under anesthesia, the canine teeth should be scaled and polished to remove plaque and calculus. Polishing should be performed with regular flour of pumice. Oils associated with polishing pastes interfere with dental adhesives bonding to tooth structure. The canine teeth are commonly used for maxillomandibular bonding. The teeth should be conditioned/etched/primed according to the manufacturer's instructions of the products you are using. Once the adhesive has been applied and cured, the canine teeth should be placed into the normal position and the cusp tips approximated. Self-curing or light curable composite can be applied to the crown surface and allowed to cure or light cured while being held in place. Light curable composites should be cured in stages and the depth of the composite should be limited to 2mm thick between curing. If using self-curing composites, 1cc syringe casings or IV tubing can be trimmed and placed over the canine tooth cusps to serve as a mold. It may be advisable to score or mark with an indelible marker the location between cusp tips to facilitate removal.

Initial removal of MMF is typically done under heavy sedation or immediately after anesthetic induction agent is given. With a diamond bur on a high-speed hand piece the composite can be cut or scored. Using calculus removal forceps or large wing tipped elevators the composite can be fractured in the weakened area. After intubation, additional composite can be removed by placing superficial longitudinal scores and pried off in segments using dental elevators, ronguers or calculus removal forceps. The crowns should be ultrasonically scaled and polished once the entire composite is removed. Any enamel damage should be documented with dental radiographs, the client informed and treated with dental restorative materials (some of which we have just discussed.)

Intraoral Composite Splints

A primary benefit to using intraoral splints for fracture fixation is that it relies on noninvasive restoration of normal occlusion for fracture reduction. Composite splints are considered a semi-rigid form of fixation. By using semi-rigid fixation, micromotion is unavoidable and may contribute to a larger callous formation than if rigid internal fixation

were applied. While micromotion may be associated with an increased risk of healing complications (fibrous union, nonunion, delayed union, etc,) micromotion may contribute to callous remodeling and promote bone healing in response to Wolff's law. Intraoral composite splints are best suited for stable fractures, ideally with reasonable anatomic reduction. By using a closed reduction technique, there is no disruption of the fracture hematoma, no periosteal disruption around the fracture site, and a decreased risk of iatrogenic exposure to bacterial contamination at the fracture site. Similar to other more invasive forms of fixation, it is important to include a minimum of two points of stabilization on either side of the fracture line. This can be particularly challenging when fractures involve removal of the mandibular first molar tooth and incorporating 2 points of fixation caudal to the fracture.

Occlusal relationships between the mandibular and maxillary arcade should be considered when planning for intraoral splint placement. The anisognathic relationship between the mandible and maxilla necessitate that the splint be placed on the buccal surface of the maxillary arcade or the lingual surface of the mandibular arcade. By avoiding occlusal interference with teeth, concussive trauma or difficulty eating can be avoided.

Intraoral splints should be considered a "load sharing" form of fixation and best used in transverse or favorable fracture orientations. Like other forms of fixation and stabilization, the intraoral splint will better withstand compression and tension forces if the distributed over a larger distance. Fabrication of a composite splint for fracture stabilization in the area of the mid body or first molar region may reasonably extend from the ipsilateral canine tooth to the mandibular third molar. Fractures in the rostral half the mandible will likely require an intraoral splint that crosses midline. Intraoral splints may have limited application for patients with mixed juvenile and adult dentition.

Kern et al. demonstrated that fixation using a combination of interdental wiring and an intraoral splint had greater ultimate strength than either form of fixation used alone. Citing a similar benefit of rebar reinforcing cement, the interdental wire may reinforce the composite and afford additional rigidity before the composite fails under load. Whenever possible, reinforcing the intraoral splint with interdental wiring may be advisable since the fixation device may remain stable enough for healing despite wire breakage or splint fracture. Various patterns of interdental wiring can be readily found in veterinary journals or oral trauma chapter of veterinary medical textbooks.

A combination of macromechanical and micromechanical retention are commonly applied to reduce the likelihood that the splint spontaneously dislodges. The divergent nature of the canine teeth serves as a macromechanical mechanism of retention when the splint incorporates these teeth. Since the gingival margins of the mandibular and maxillary canine teeth are divergent, there is natural retention preventing an intraoral device from sliding off. Macromechanical retention is further improved by the presence of the interdental wiring. Loops and twists create an additional irregular surface for the composite to flow. Micromechanical retention may be desirable in some, but not all cases. Additional 'staying' power of the composite can be utilized through the use of tooth conditioning agents which provide a hybrid zone which permit the composite resin to form a chemical bond to the tooth structure. Use of tooth conditioning techniques and

dental adhesives are necessary to create the “hybrid zone” (hydrophobic surface) necessary for chemical adhesion between the adhesive and composite. Specifics about tooth conditioning and application of dental adhesives is further discussed in textbooks describing splint fabrication and placement.

Self-curing and light cure composites may be used for splint fabrication. Light cured composites may be cost prohibitive for use in dogs but may be sufficient for cats. Since light curing the composite is necessary and frequent, these procedures will take longer and may be somewhat technically sensitive. Use of provisional crown and bridge self-curing composite is used more commonly, especially for composite splints in dogs. Layers of composite are applied to the tooth surfaces and unless the composite is expressed very slowly and constantly applied, it is reasonable to expect that the self-mixing tips will be replaced several times during splint fabrication.

Because the splint relies on micromechanical and macromechanical retention, circumstances exist where interdental wiring may not be possible or insufficient tooth surface area exists for reasonable chemical adhesion. In these situations, the use of mandibular cerclage wires can create the necessary macromechanical retention. Mandibular cerclage wires are placed prior to composite application and wire ends secured once most of the composite splint has been placed and cured. A second layer of composite is then placed over the splint in the oral cavity to ensure that soft tissues are not traumatized by sharp wire ends.

Mandibular cerclage wires can be preplaced through the use of simple stab on incisions in the ventral mandible. A combination of blunt and sharp dissection to the ventral cortex of the mandible will allow the use of a 1 ½” needle to guide the orthopedic wire. The role of the cerclage wire is to secure the composite splint against alveolar bone. 24g to 20g wire can be used depending on the size of the patient. A corresponding 18 to 20g needle can be used to direct and pass the wire through soft tissue. The needle should be directed through the stab incision alongside the lingual cortex of the mandible and penetrate sublingual mucosa as close the gingiva as possible. Orthopedic wire can be threaded through the needle with a free end existing the mouth. Beginning orally, the needle can then be directed through alveolar mucosa along the buccal cortex and the bevel tip directed through the ventral stab incision. Care should be taken to ensure the needle travels along bone and exits the stab incision in order to minimize trapping soft tissues once the wire is secured. The wire can be threaded into the bevel and needle withdrawn guiding the free end into the oral cavity. Preplacing cerclage wires with free ends in the oral cavity improve splint and wire removal since there will be no buried twists. After a majority of the splint has been formed, the wire twists ends are twisted to secure the splint against the alveolar crest or existing teeth. By placing the wire twists in the mouth, at the time of removal the cerclage wires simply need to be cut.

Use of intraoral splints can be challenging when trying to treat caudal mandibular fractures. Fractures involving the mandibular first molar tooth can become particularly challenging because of their common nature and considering the large surface area of the mandibular first molar, removal of the tooth can significantly reduce the micromechanical bonding potential of the composite. The low profile, and the tapered anatomic confirmation of the second and third molars are both features that limit the potential for

enhanced macromechanical retention. To stabilize and seat the splint in this area, additional retentive techniques may be necessary such as mandibular cerclage wires or placement of transmucosal screws along the rostral surface of the alveolar ridge of the coronoid process. While it only affords a single point of anchorage, passing the interdental wires through a hole drilled at the transition of the mandibular body to vertical ramus may offer additional point of anchorage.

Once the splint is placed, clients should be counseled that the animal should only eat liquefied or softened food for the duration of the fixation device. Hard toys, tug of war and rough housing should be prohibited. Recommended daily care of the splint should include irrigating the splint with water twice daily after eating and the use of a medicated oral rinse may help reduce mucositis and halitosis. Intraoral splints can be removed under general anesthesia after radiographic evidence of healing exists.

Removal Techniques

Removal of the composite can be challenging but should be straightforward. Scoring the composite using a diamond bur should create areas of weakness that a large dental elevator should be able to fatigue and fracture off segments. Wire cutters or a diamond bur can be used to cut the mandibular cerclage wires and the wires should be able to be pulled into the oral cavity with steady tension. Particular care should be taken when scoring the composite around tooth structure. Radiography may help determine the interproximal spaces if someone is unsure. The more areas the composite is scored, the weaker it will be and easier to facilitate removal. Any tooth damage should be treated with a dental restoration. Immediately after removal of the splint, gingivitis/mucositis may be seen. While there should be no inherent discomfort associated with splint removal, a short course of anti-inflammatory medication or topical mucositis solution may benefit the patient. Small pieces of composite bonded to tooth structure can be ultrasonically or hand scaled to facilitate removal. Placement of acrylic or composite splints without conditioning the tooth structure first may result in much easier splint removal but lacks the micromechanical retentive qualities of the appliance.

Symphyseal Separation

Treatment for symphyseal separation is focused on: anatomic reduction of the right and left mandibles, and restoration of normal occlusion. Remember that the mandibles in canines and felines are not fused and are made up of a fibrocartilagenous joint. Even in healthy patients, laxity can sometimes be over interpreted as pathologic. If there is no evidence of soft tissue laceration, any attempt to stabilize a lax symphysis without soft tissue disruption will likely not result in any reduced movement once the fixation is removed. True pathologic conditions of laxity of the mandible can only be remedied through open debridement and stabilization to encourage arthrodesis across the joint, which is rarely indicated. Most frequently, treatment for symphyseal separation is accomplished with either a single mandibular cerclage wire caudal to the canine teeth, or with a rostral mandibular composite splint +/- interdental wiring. A modification to the mandibular cerclage wire is to place the wire twists within the mouth and cover the wire ends with a small amount of composite to prevent soft tissue trauma. This

modification reduces the invasiveness of mandibular cerclage wire removal since a single cut to the wire will result in the complete removal in the oral cavity as compared to surgically exploring the ventral mandible to remove wire twists embedded in muscle and skin.

References:

1. Hennet PR, Harvey CE. Craniofacial development and growth in the dog. *J Vet Dent* 1992;9(2):11-18.
2. Kern DA, Smith MM, Stevenson S, et al. Evaluation of three fixation techniques for repair of mandibular fractures in dogs. *J Am Vet Med Assoc.* 1995;206(12):1883-90.
3. Kern DA, Smith MM, Grant JW, et al. Evaluation of bending strength of five interdental fixation apparatuses applied to canine mandibles. *Am J Vet Res*. 1993;54(7):1177-8.
4. Niemiec BA. Intraoral acrylic splint application. *J Vet Dent.* 2003;20(2):123-126.
5. Wiggs RB, Lobprise HB. Oral Fracture Repair. In Wiggs RB, Lobprise HB eds. Veterinary Dentistry Principles and Practice. Philadelphia, PA: Lippencott - Raven; 1997. p 259-279
6. Wiggs RB, Lobprise HB. Oral anatomy and physiology. In Wiggs RB, Lobprise HB eds.
7. Veterinary Dentistry Principles and Practice. Philadelphia, PA: Lippencott - Raven; 1997. p 55-86
8. Lothamer C, Snyder CJ**,** Duenwald-Kuehl S, Kloke J, McCabe RP, Vanderby Jr. R. Crown preservation of the mandibular first molar tooth impacts the strength and stiffness of three noninvasive jaw fracture repair constructs in dogs. *Front Vet Sci*. 2015;2:18
9. Beckman B, Smith MM. Interarcade bonding for non-invasive mandibular fracture repair. *J Vet Dent.* 2009;26(1):62-6.
10. Hoffer M, Manfra Marretta S, et al. Evaluation of composite resin materials for maxillomandibular fixation in cats for treatment of jaw fractures and temporomandibular joint luxations. *Vet Surg.* 2011;40(3):357-368.
11. Legendre L. Intraoral acrylic splints for maxillofacial fracture repair. *J Vet Dent* 2003;20(2):70-78

Surgical Approaches for Oral Tumors

Christopher J. Snyder, DVM, DAVDC, DEVDC

Overview of the Issue

Less than 10% of all diagnosed forms of cancer are found in the oral cavity. Rostral tumors carry a more favorable prognosis for both surgery and long-term survival however this may partly be due to the fact that caudal tumors in the oral cavity may not be identified until they are much larger. Similarly, the caudal oral cavity is rich with complex anatomy which complicates surgical treatment such as the eyes, nasal cavity, large neurovascular structures and the brain. Early identification with appropriate biopsy and tumor staging offers the best chance for treatment intervention and a positive quality of life with good long-term survival. Selection of the appropriate tissues for biopsy and accurate description of the clinical presentation (+/- photos and radiographs) provide the pathologist with the best clinical picture with which to make their histologic interpretation.

Simply put, the earlier any oral irregularity is noticed, biopsied and diagnosed, the more treatment options that may be available. In many cases, oral tumors can be identified at very early stages, coincidently during routine anesthetized dental cleanings and oral exam. Any irregularity should be photographed or at least well described in the medical record to afford subsequent comparative oral evaluations to document change. At a minimum, masses or oral tissue irregularities incidentally found during professional cleanings should be biopsied and placed in formalin. In cases where the client is reluctant to submit the sample for histologic evaluation, the sample can either be stored in the clinic or sent home with the client (dependent on state law) and the biopsy site monitored. Any recurrence of the condition or poor tissue healing should prompt submission of the sample for evaluation.

When biopsying any tissues juxtaposed to bone, diagnostic imaging can be helpful to both help gauge extent of local involvement, and more importantly, guide which tissues should be sampled for evaluation. Whenever radiographic evidence suggests bony involvement, that abnormal tissue should be included in histologic sample submission. Intraoral radiography is best for evaluating for local involvement of bone but may be difficult to determine extension into the nasal cavity if the mass is predominately soft tissue in origin. In clinical environments where computed tomography (CT) is available, the additional information afforded by CT scans may be helpful in more clearly delineating the true extent of pathology while also providing useful diagnostic information such as enlarged retropharyngeal lymph nodes. The more sensitive imaging for the extent of pathology is also necessary in surgical planning for definitive surgical oncologic treatment. Additionally, CT of the thorax would be more sensitive to demonstrating subtle evidence of metastasis. Instances where the tumor may be radiation sensitive, a disadvantage of CT at the time biopsy is that many radiation oncologists prefer an accurate CT of the patient patient's anatomy which is necessary for radiation therapy planning. Biopsy following the CT may render the CT not useful for radiation treatment planning due to the altered anatomic structures. In the author's experience, head CT may be particularly useful for biopsy planning of any patient demonstrating signs of nasal cavity involvement of an oral tumor. Epistaxsis, nasal or ocular discharge or altered air flow through the nasal cavity may prove useful for head CT. In some instances, nasal tumors may not be evident until they perforate into the oral cavity and in other situations oral tumors may be grossly underestimated due to limited intraoral presentation while extensive invasion into the nasal cavity has occurred. Prevalence of cone beam CT in veterinary medicine has lowered the barrier for entry to have advanced imaging in more

practices. CBCT demonstrates excellent imaging for bone but still pales in comparison to contrast and evaluation of soft tissues. Patients with pain upon opening the mouth, altered globe position or difficulty or painful retropulsion should also warrant CT at the time of biopsy to ensure appropriate tissues are sampled.

Characteristics of malignant oral tumors can include osseous production or destruction based on tumor type. Typically, malignancies are less well defined than benign processes and may even destroy tooth structure. Both benign and malignant tumors are capable of displacing tooth structures however many benign processes typically maintain normal surrounding tissue architecture.

Tumor Staging

Oral tumor should be staged according to the World Health Organization's tumor classification system. Appropriate imaging of the thorax (radiographically or with CT) should accompany fine needle aspirates of the draining lymph nodes. Mandibular lymph nodes are most commonly sampled however in one study, only 54% of oral tumors with metastatic disease included metastasis to the mandibular lymph node. Sampling of all the lymph nodes draining the head are recommended for the most thorough evaluation.

Most Common Malignancies

Malignancies in dogs and the recommended surgical margins, in order of common occurrence include: malignant melanoma (2-3cm), squamous cell carcinoma (2cm) and fibrosarcoma (3cm). Most common malignancies in the oral cavity of cats and recommended surgical margins include: squamous cell carcinoma (2cm), fibrosarcoma (3cm) and malignant melanoma (2-3cm). By working closely with your medical oncologist, clients can be offered the best sense of primary treatment options including radiation or chemotherapy as well as necessary surgical follow up treatments including radiation or chemotherapy.

Principles of Surgical Resection and Necessary Follow Up

Maxillectomy

Appropriate treatment planning for surgery in the maxilla almost always includes CT. Identification of necessary anatomic structures to be involved within surgical margins as well as an appreciation of nasal cavity, peribulbar or caudal oral cavity involvement provides the best chance for complete successful resection. Major neurovascular structures are commonly encountered with caudal maxillectomies and major blood loss should be given careful pre-surgical consideration. Tension-free closure provides the best opportunity for surgery sites to heal predictably. Resections involving maxillary bone requiring closure oronasal communications are further complicated in healing by risk of oronasal fistula formation. Patients should be discharged with Elizabethan collars to discourage facial rubbing and attempting to chew on prohibited items during the post-operative healing period. Wound dehiscence of maxillectomies is reported to be common, involving 7-33% of cases and 80% of wound dehiscence is reported to occur caudal to the canine teeth. While local surveillance is always recommended, even when clean surgical margins are reported histopathogically, CT may be recommended to monitor for recurrence in the nasal cavity surface of the resection.

Mandibulectomy

Patients treated with a mandibular resection should also be carefully considered for inter-operative hemorrhage. The mandibular artery/vein/nerve entering the mandibular foramen and becoming the

inferior alveolar artery/vein/nerve should be carefully isolated and ligated whenever possible. Mandibular surgeries are impacted differently by tension. Contracture by muscles of mastication can create situations of tension. Whenever a portion of the mandible is removed caudal to the symphysis, the mandibular segments tend to collapse towards midline. This is referred to as mandibular drift and monitoring for traumatic contact by the mandibular canine tooth onto the hard palate, occluding teeth or the upper lip can all result in situations where intervention and treatment may be necessary. Use of orthodontic elastics can prove to be helpful in preventing the development of mandibular drift during the post-operative period while other patients may require long term orthodontic elastics to maintain a normal occlusion. Even following successful healing of oral soft tissues, tooth vitality of teeth rostral to the resection should be monitored radiographically to ensure pulpitis and non-vitality did not result with disruption by the mandibular artery/vein. When appropriate, a mandibular rim excision is a method for removal of a portion of the mandible where ventral cortex is maintained and therefore collapse is avoided.

Reconstruction Efforts

Reconstruction efforts have become more popular by recent advancements and availability of reconstruction techniques used in humans. Reconstruction may be helpful in returning the patient to a pre-surgical normal, functional and comfortable occlusion. Mandibular drift is recognized as contributing to the unusual temporomandibular joint relationship while the extent of clinical discomfort associated with degenerative changes is unknown. In many situations cases eligible for reconstruction utilize 3-D printing of the patient's head, expensive implant hardware and may involve difficult to acquire regenerative biologics.

Veterinary patients tolerate major oral surgery quite well, yet successfully mask oral tumors which complicates early diagnosis and possibly surgery. To provide the best chance for a definitive surgery with predictable healing and successful outcome, early identification, radiographic evaluation, and representative biopsy are necessary. Post-operative local surveillance as well as monitoring for the teeth rostral to the surgery site typically become the referring veterinarian's responsibility.

References:

1. Arzi B, Cissell DD, Pollard RE, Verstraete FJ. Regenerative approach to bilateral rostral mandibular reconstruction in a case series of dogs. Frontiers in veterinary science. 2015 Mar 30;2:4.
2. Arzi B, Verstraete FJ. Clinical staging and biopsy of maxillofacial tumors. Oral and Maxillofacial Surgery in Dogs and Cats-E-Book. 2019 Aug 23:415.
3. Sarowitz BN, Davis GJ, Kim S. Outcome and prognostic factors following curative-intent surgery for oral tumours in dogs: 234 cases (2004 to 2014). Journal of Small Animal Practice. 2017 Mar;58(3):146-53.
4. Verstraete FJ, Lommer MJ, editors. Oral and maxillofacial surgery in dogs and cats. Saunders/Elsevier; 2012.
5. Verstraete FJ. Mandibulectomy and maxillectomy. Veterinary Clinics: Small Animal Practice. 2005 Jul 1;35(4):1009-39.
6. Zacher AM, Marretta SM. Oral and maxillofacial surgery in dogs and cats. Veterinary Clinics: Small Animal Practice. 2013 May 1;43(3):609-49.

Feline Chronic Gingivostomatitis: Insights from Current Treatment Perspectives

Christopher J. Snyder, DVM, DAVDC, DEVDC

OVERVIEW OF THE ISSUE

There are many instances in veterinary practice where cats cannot be treated the same as small dogs. Veterinary dentistry is no different. While the prevalence of periodontal disease in cats is similar to the widespread prevalence seen in dogs, other conditions show up much more frequently in cats such as tooth resorption and generalized stomatitis. The prevalence of tooth resorption and stomatitis in cats remains greater than any other species and remains problematic and frustrating to treat. Fortunately, many cats with stomatitis tend to be successfully managed in private practice. Those that demonstrate failure to respond to treatment may require creative intervention.

Early stages of feline chronic gingivostomatitis is typically confined to just the gingiva. As inflammation spreads and involves other tissues, diagnosis becomes more conclusive. During the early stages where inflammation is limited to the gingiva, periodontal disease (as common in cats as it can be in dogs- up to 80% over the age of 3 years) and tooth resorption should be ruled out. While periodontal disease in felines is a disease condition of attachment loss of by constituents of the periodontium, the practitioner must be cautious about deciding how aggressively to treat periodontal disease. Efforts to rehabilitate locations affected by periodontal disease may undermine the ultimate treatment recommendation of extraction for management of stomatitis patients. To further complicate matters, teeth affected by Type 2 tooth resorption (replacement resorption of the root and loss of the periodontal ligament space) should not undergo crown amputation since retention of root remnants may continue to contribute a trigger or nidus for stomatitis.

STOMATITIS

Feline stomatitis is currently referred to as feline chronic gingivostomatitis (FCGS). In previous naming iterations of the condition, it had most recently been called *lymphoplasmacytic gingivostomatitis (LPGS)*. The condition involves inflammation and widespread involvement of structures in the mouth including gingiva, mucosa, and may extend to include the tongue and palatoglossal arches. Etiologies of this condition are poorly understood and seem to impact three different demographics of cats. The earliest manifestation of the condition occurs in kittens at the time of vaccines. It is unknown if this is related to vaccine administration or the eruption of deciduous teeth. The second phase of life associated with stomatitis is at the time of the eruption of permanent teeth. The last phase of commonly associated with stomatitis is in adulthood. Breed predispositions may include Maine Coons and Siamese breeds (in Europe) while other studies demonstrate no breed predilection. Calici virus has been proposed to be associated with stomatitis development with 70-90% of cats testing positive compared with 20% of the general population. It is believed that the virus may damage host cell membranes easing the penetration of antigenic stimuli. Many cats demonstrate increased globulins on blood work suggesting an immune response, possibly due to a hypersensitivity to oral flora. Proposed triggers for hypersensitivity have also included constituents of the periodontal ligament structure or the tooth itself (as evidenced by refractory symptoms persisting only until tooth roots remnants are removed.) Working up these patients should include a biopsy of effected tissues, a thorough cleaning and meticulous homecare. This combination offers the best chance for medical management for patients affected by this condition. Testing for FeLV and FIV may be recommended since an aberrant immune system related to concurrent disease may

negatively impact the prognosis for achieving a well-controlled state long term in these patients. Cases non-responsive to medical management improve with dental extractions (as high as 87% demonstrate some degree of improvement). Cats living in multi-cat environments may be more commonly affected early in life which may be possibly associated with increased stressors and the transmission of unknown viruses or microorganism triggers. In affected cats, bacterial culture and sensitivity has not been touted as providing fundamental indication guiding successful treatment. Aside from a normal population of oral flora, one study has reported a high proportion of cats positive with a pure culture of *Pasturella multocida*. Any antibiotic use prior to surgery (to improve the health of tissues) should provide adequate coverage for the *Pasturella* species such as amoxicillin-clavulanic acid or doxycycline.

Mast cells have been established to be present in the gingiva of cats affected with periodontitis, FCGS and tooth resorption by Arzi, Murphy et al. The presence of mast cells in all three disease conditions despite the associated degree of inflammation suggests the mast cells may be reactive to an antigenic or non-antigenic stimulus. Involvement of the cell type is can be associated with the release of cytoplasmic pro-inflammatory mediators which contributing to the presenting pathology. A variety of genetic or infectious causes have been suggested. These mast cells play an integral role not only in host immune response to triggers, but also an important mediator of inflammation and tissue repair. Because of the nonspecific involvement of mast cells in FCGS, investigative treatment approaches remain focused on identifying a cause or trigger for the condition.

Biopsy is commonly performed to aid in ruling out the presence of neoplasms (squamous cell carcinoma or lymphoma) which could be at risk for developing due to malignant transformation of chronically inflamed tissues. The author has seen two cases of non-healing extraction sites which had been biopsied prior to completing full mouth extractions. Feeling comfortable about the absence of malignancy makes the idea of full mouth extractions a more palatable treatment to the client and reasonable for the patient. Distribution of inflammatory cells in the histopathology report may also suggest whether the patient is suffering from an advanced case of severe periodontal disease (inflammatory cells +/- bacteria found in superficial cell layers) versus an FCGS case where inflammatory cells are expected to be found deeply infiltrating tissues.

During initial treatment and work-up of FCGS cases, routine preanesthetic blood work should be performed to rule out concurrent metabolic disease conditions that may impact anesthetic risk (renal disease, hepatic disease) or impact post-surgical healing (diabetes). Once anesthetized, patients should receive a thorough dental cleaning and oral examination. Dental radiography should be performed evaluating for any reasons indicating extraction (tooth resorption, endodontic disease, retained root fragments). Cats demonstrating signs of stomatitis have been shown by Farcus et al., to be more greatly affected by horizontal bone loss, suffer external inflammatory resorption and have more retained roots. Teeth affected by tooth resorption should undergo complete extraction regardless of the presence of periodontal ligament seen radiographically (*Types 2* and *3*) since elements of the tooth structure or periodontal ligament may contribute as trigger for the hypersensitivity. Diligent home care aimed at plaque control with tooth brushing, oral rinses (chlorhexidine), topical gels (bovine lactoferrin), systemic antibiotics and recommendations for dental diets may aid in the management of symptoms. Doxycycline would be an appropriate for antibiotic of choice, started at the therapeutic dosage of 5mg/kg q12hrs and potentially reduced to a sub-antimicrobial dose of 2mg/kg q12hrs. Aside from being the appropriate

spectrum of microflora, doxycycline demonstrates properties of being actively concentrated in secreted in gingival crevicular fluid as well as functioning as an anti-collagenase. Patients not responding to the first attempts at medical management require dental extractions of either partial mouth, or full-mouth extractions. Patients demonstrating a hypersensitivity to normal oral flora may demonstrate limited improvement on broad-spectrum antibiotics however the opportunistic infection may be better managed.

Other medical therapies mentioned in the literature have included other immunomodulatory drugs and chemotherapeutics. In a study by Hennet, feline recombinant interferon omega was shown to be an effective treatment in refractory cases of stomatitis following extraction in which cats were Calici virus positive. Omega interferon has been successful in symptom management when delivered *per os* and is believed to incite a cytokine cascade resulting in immunomodulatory effects in the mucosal tissues. Variations on the administration of Omega interferon have been reported to include submucosal injections and oral gavage. One dosing regimen involves diluting a 10mu vial in 100mL bag of sterile saline and ten fractions of 10mL are created and frozen. One 10mL vial is dispensed at a time where 1mL is administered daily on alternating sides of the mouth. This results in treatment for 100 days. Submucosal (intralesional) administration of omega interferon has subsequently been suggested to be not as effective and more costly. Recent information suggests that autogenous stem cell therapy may offer hope for cats refractory to other treatments for FCGS. In a study by Arzi, 5 of 7 cats demonstrated improvement in oral inflammation following autogenous adipose-derived stem cells that were administered intravenously. Obstacles remain as to the use of this technique in clinical practice, however novel experimental approaches frequently result in the commercialization of the therapy.

More frequently, selective or full mouth extractions are necessary to remove the nidus for inflammation. In general, the more generalized and severe the inflammation, the less likely it is that selective removal of teeth will provide complete resolution of clinical signs. Complete removal of teeth, in this situation, may offer a 60% chance for complete return to a normal mouth without inflammation if there is no evidence of inflammation into surrounding tissues (lateral aspects of the tongue, lip folds, or mucocutaneous junctions.) Because of the extreme invasiveness of full mouth extractions, these cases should be initially managed with a combination of dental cleanings, selective extractions and home care. Because the nidus for the hypersensitivity is never completely removed in these animals, some patients continue to relapse with severe clinical signs. Full mouth extractions both minimize the tooth surface for plaque accumulation as well as remove the physical tooth structure and periodontal ligament structure, which may serve as the overt cause of the hypersensitivity. It does seem well established that the more generalized and severe the disease, the less of chance the mouth will respond completely to full mouth extractions however room for improvement usually results.

In a study by Hung et al., bovine lactoferrin was shown to augment and extend improvements in clinical symptoms, lesion symptoms, quality of life and body weight scores in cats with stomatitis. Lactoferrin is protein rich with approximately 700 amino acids and a strong iron binding affinity. The proven antimicrobial, anti-inflammatory and anti-carcinogenic properties are attributed with reducing interferon-y and IL-2. Applied topically as a spray twice daily, cats showed a significant long-term improvement of lesions and quality of life scores as compared to the piroxicam-only group. After 4 weeks of either the combination or the just piroxicam, all cats were placed on the combination of lactoferrin and piroxicam. Following the completion of the 12-week study, cats were maintained on twice-daily lactoferrin

indefinitely with more than 50% of those cats continuing to demonstrate improvement of clinical signs and improved quality of life. Overall, piroxicam was shown to significantly improve symptom scores acutely, and the addition of lactoferrin augmented improvement of symptoms, lesions, quality of life and patient body weight. Lactoferrin's impact on symptomology is likely associated with "strong antimicrobial effects" and function as an immune modulator and anti-inflammatory agent inhibiting proliferation of peripherally circulating monocytes and down regulation of cytokines.

Carbon dioxide (CO_2) laser treatment has been suggested as a treatment for refractory cases of stomatitis following full mouth extractions. Laser ablation of affected tissue results in reorganization and scar tissue formation, which is believed to be associated with less discomfort. Ablation of the proliferative and friable tissue found in the palatoglossal arches is also believed to remove a source of tissue riddled with deeply seeded bacteria which contribute as a trigger for the immune response.

Use of diets or supplements high in omega-3 fatty acids have been proposed to aid in the modulation of inflammation associated with stomatitis. Anecdotal reports have suggested that omega-3 fatty acids may affect platelet function and result in additional hemorrhage at the time of extractions. One study looking at omega-3: omega-6 ratios showed decreased pro-inflammatory cytokines in serum however there was no noticeable improvement in the health of the oral tissues during the four-week period of the study.

Extended medical management should only include immunosuppressive doses of steroids if absolutely necessary. Oral dosing of prednisolone suspensions offers the best opportunity to titrate the dose and minimize side effects. Stomatitis patients frequently show a favorable improvement in clinical signs and manifestations from oral administration of doxycycline. Doxycycline should be administered as a suspension and can begin at 5mg/kg twice daily. Aside from bactericidal/bacteriostatic properties of this antibiotic, it also demonstrates anti-collagenase properties, blocks matrix metalloproteinase (MMPs) and has been shone to concentrate in the crevicular fluid. Some cats may benefit from this medication lifelong with the goal that the titrated maintenance dose is sub antimicrobial.

As an adjunct, and ideally a replacement for steroid therapy, cyclosporine has shown promise both anecdotally and in the literature for management of refractory cases. To date the best responses to treatment have been centered on removing the likely inflammatory trigger (oral bacteria or tooth itself) or modulating the immune system. In one study by Lommer, refractory cases having received partial-mouth or full-mouth extractions were placed on cyclosporine at 2.5 mg/kg q12hrs or placebo. Six weeks following initiation of treatment, >50% improvement was noted in cats with stomatitis receiving the treatment. Further analysis suggests that achieving a serum cyclosporine level >300ng/mL showed an improvement in stomatitis symptoms in 72% of patients. Despite being more expensive, use of cyclosporine for the management of refractory cases offers symptomatic management without steroids' side effects.

SUMMARY

All indications, both from histologic and response to treatment perspectives point to FCGS occurring as a result of an antigenic trigger. While the true etiology of the condition remains elusive, new information is constantly being unearthed. Without a silver bullet treatment for the condition, current recommendations still hold true to the stepwise process of: ruling out comorbid disease states, dental cleaning, biopsy the

mouth to rule out neoplasia, and first attempting home care and non-invasive medical management (doxycycline therapy, topical medicaments) before resorting to extractions. If, following extractions there is failure for improvement in patient comfort and tissue health, a variety of other treatment modalities can be pursued including laser ablation, cyclosporine and steroid therapy.

References/Suggested Reading

1. Special Issue Feline Dentistry Part 2. Journal of Feline Medicine and Surgery 2015;17(1)
2. Farcas N, Lommer MJ, Kass PH et al. Dental radiographic findings in cats with chronic gingivostomatitis (2002-2012). J Am Vet Med Assoc 2014;244:339-345
3. Hennet P. Chronic gingivostomatitis in cats: long term follow-up of 30 cases treated by dental extractions. J Vet Dent 1997;14:15-21.
4. Hung YP, Yang YP, Wang HS et al. Bovine lactoferrin and piroxicam as an adjunct treatment for lymphocytic gingivitis stomatitis in cats. Vet J 2014;202:76-82
5. Lommer MJ. Efficacy of cyclosporine for chronic, refractory stomatitis in cats: a randomized, placebo-controlled, double blinded clinical study. J Vet Dent 2013;30(1):8-17
6. Arzi B, Mills-Ko E, Verstraete FJM, et al. Therapeutic Efficacy of Fresh, Autologous Mesenchymal Stem Cells for Severe Refractory Gingivostomatitis in Cats. Stem Cells Translational Medicine, 2016;5(1), 75–86
7. Winer JN, Arzi B, Verstraete FJM. Therapeutic Management of Feline Chronic Gingivostomatitis: A Systematic Review of the Literature. Frontiers in Veterinary Science, 2016;3(Suppl 1), 54.
8. Anderson JG, Peralta S, Kol A, Kass PH, Murphy B. Clinical and histopathologic characterization of canine chronic ulcerative stomatitis. Vet Path. 2017;54(3):511-519.
9. Gracis M, Reiter AM, Ordeix L. Management of selected non-periodontal inflammatory, infectious and reactive conditions. BSAVA Manual of Canine and Feline Dentistry and Oral Surgery, 4th ed. Reiter AM, Gracis M, eds. BSAVA 2018
10. Lee DB, Verstraete FJM, Arzi B. An update on feline chronic gingivostomatitis. Vet Clin Sm Anim 2020: 1-10
11. Peralta S, Carney PC. Feline chronic gingivostomatitis is more prevalent in shared households and its risk correlates with the number of cohabiting cats. *J Fel Med Surg*, 2019;21(12):1165–1171

Cleft Palates: Best Approaches for Better Outcomes

Christopher J. Snyder, DVM, DAVDC, DEVDC

Oronasal Fistula Injury and Repair

Various causes exist associated with the development of oronasal communications. Regardless of the cause, symptoms tend to be the same and are focused on contents of the oral cavity accumulating in the nasal cavity.

Cleft Palate versus Oronasal Fistula?

Communications between the oral and nasal cavities result in exchange of air, saliva and oral contents between both locations. Cleft palates are developmental abnormalities resulting in communication between the oral and nasal cavities. Clefts result from failure of migration and closure of the maxillary palatal shelves (secondary clefts) or failure of fusion by the maxillary process and medial nasal process (primary clefts). Clefts can involve the hard and/or soft palate. An oronasal fistulas (ONF) may, or may not, occur at the same location as a clefts, however ONFs more commonly result from complications with maxillary tooth extractions or following major maxillary oral surgery. Generally speaking, regardless of the cause of the lesion, more caudal defects are associated with worse symptoms.

Cleft Palate Defects

Cleft palate defects occur when there is a failure for migration or fusion between the nasal processes with maxillary processes (resulting in a primary cleft palate) or failure for fusion of the maxillary shelves along midline (resulting in formation of a secondary cleft palate.) Cleft palate defects may be the most difficult condition to repair due to the nature of the available tissues. The edges of the tissues in cleft palate cases involve small vessels frequently transitioning from arterial to venous return. In other instances of oral surgery, cutting through tissues with large vessels provides tissue edges with a robust blood supply. In the case of clefts, since these vessels are small and not as robust, complete or multifocal areas of nonhealing commonly occur. Clients owning pets receiving repair of a cleft should be prepared for the possibility for multiple revisions necessary following the primary repair.

Cleft Palate Repair Techniques

A large number of cleft palate repair techniques exist in human and veterinary literature mostly because of the extreme difficulty that these cases present. Since the largest challenge with tissue healing is centered over issues with blood supply to the edges of the cleft defect, performing techniques which preserve palatal blood supply are a good place to start. The major palatine artery nerve and vein emerge from the palatine foramen and travel rostrally.

Techniques that permit freeing the palatal mucosa and shift it toward midline would be the best first approach to repair since these vessels would be preserved to the roof of the mouth and future revision surgeries could count on the tissue maintaining blood supply from this source.

Cleft lips and primary cleft palates typically occur together. It is reasonable to stage these procedures and attempt to repair the cleft lip first as is sometimes performed in people. The advantage to repairing a cleft lip first, is that if the entire cleft lip and primary palate are

repaired together, failure at any point along the repair could result in complete dehiscence. It is believed that if the lip heals successfully, repair of the primary cleft palate will be better anchored by stable tissue and less likely to dehisce.

Mucosal advancement flaps commonly involved staged procedures where teeth are extracted and extractions sites are allowed to heal, provide large surfaces of oral palatal and buccal mucosa to be undermined and advanced toward midline. Edges of the cleft palate that are to be sutured should be thoroughly debrided and de-epithelialized to encourage healing. Since palatal mucosa does not stretch, ample areas of tissue should be undermined and freed up to enable a tension free closure. Releasing incisions perpendicular to the cleft may be necessary to enable mobilization of the flap to midline and efforts should be made to preserve the palatine vessels.

Modified von Langenbeck technique involves maintaining the major palatine vessels from the caudal aspect of the flap as well as maintaining anchorage of the rostral aspect of the flap. In this technique, incisions are made at the cleft where the intraoral surface reflects into the nasal cavity and a second incision is made several millimeters palatal from the teeth. Since the tissue is anchored rostrally and caudally, the flap is undermined and freed from the palate with care not to disrupt the palatine vessels. By performing this technique on both sides of the midline cleft, the palatal tissues are slid together and closed over the area devoid of bone. This technique does leave strips of hard palate exposed to heal by second intention. While this technique offers the ability to maintain dentition, the largest obstacle to healing with this technique is having the suture line closed and unsupported by bone. Efforts to reinforce the suture line with support could include use of cortical bone membrane, fascial graft or a sheet of swine intestinal submucosa placed beneath flap. The author has had success with this technique and frequently requires minimal revisions only due to multifocal oronasal communications in areas where complete epithelialization takes place.

The *hinged overlapping flap technique* offers the benefit of only disturbing palatal tissue on one side of the cleft defect. Using this technique, again attempting to preserve the major palatine vessels, involves creating a hinged flap of palatal mucosa which is elevated from one side of the cleft and attached to mucosal edge of the cleft on the opposing side. A disadvantage to this technique includes that the major palate vessels in the flap may need to be ligated in order
to appropriately hinge the flap and tuck the incised free edge of the flap beneath the opposite recipient edge of the cleft. When enough tissue exists, the advantage to this flap is the that the suture line could be supported by bone. The donor side of the flap is left to heal by second intention and the undersurface of the flap which was elevated off the hard palate, is left to be exposed to the oral cavity and heal by secondary intention.

Causes of ONFs

Thin alveolar bone exists separating the maxillary canine teeth from the nasal cavity. Severe periodontal disease resulting in alveolar bone resorption or inappropriate placement of a dental elevator or luxator along the palatal aspect of the canine tooth risk creating a communication between the nasal and oral cavities. The propensity for small breed dogs to develop periodontal disease as well as the relatively large tooth/root size relative to supporting bone both may contribute to these findings. ONF development secondary to

dental extraction can be prevented by only elevating maxillary canine teeth along the mesial and distal surfaces of the tooth as well as adequate buccal bone removal to facilitate extraction. Difficulties elevating along the mesial aspect of the tooth can sometimes be alleviated by removing the tooth crown which results in a more straight-line access for elevation. Aside from removal of the crown, creating mucogingival flaps for closure without tension should always be a top priority. Tension at the surgical extraction sites is commonly blamed as the number one cause for dehiscence. Appropriate flap release with an airtight closure should result in appropriate healing even when communication exists between the alveolus and nasal cavities.

Complications with major oral surgery may also result in oronasal fistula formation. It has been reported that 70% of ONFs developing following major oral surgery tended to occur in resections caudal to the canine teeth. Underlying reasons for this may include larger surgeries, more complicated anatomy, resultant masticatory forces acting on the surgery site or increased difficulty with attaining clean margins. Development of surgery site dehiscence is typically acute and no further surgery should be attempted before histopathologic conformation of clean margins is available.

Other processes resulting in unhealthy palatal tissue may also result in ONF development. Neoplasia, pressure necrosis related to foreign bodies trapped against the hard palate and autoimmune conditions such as eosinophilic granuloma complex can also result in an oronasal communication. Radiation therapy of the nasal cavity has also been related to devitalization of areas of the hard palate and subsequent ONF development.

ONF Repair

Advancement flaps

Repair of ONFs should be focused on creating soft tissue flaps that are: well vascularized, closed without tension and having sutures placed in a manner which results in an airtight closure. Most ONFs will be successfully repaired with soft tissue flaps involving gingiva, alveolar or buccal mucosa. The hallmark of repair involves creating wide based flaps with incision lines sutured together while being supported by bone. Suturing flaps with incision lines unsupported by bone risks tension created by the tongue or pressure from a food bolus. Both sources of tension risk dehiscence. Some instances of treatment may necessitate the extraction of neighboring teeth to the location of the flap harvested to close the defect. Sufficient time for soft tissue healing (6 weeks) should be allowed when extractions take place in effort to elevate a mucogingival flap for the closure of an ONF. Defects located in the soft palate or at the soft palate - hard palate junction have been repaired with a split thickness advancement flap of soft palate (muscle) and overlying oral mucosa advanced to repair the lesion.

Rotational flaps

Rotational flaps are sometimes referred to as transposition flaps. The split palatal U-flap has been described and used with clinical success for the repair of ONFs originating at the caudal hard plate or soft palate location. This technique uses two pedicle flaps extending rostrally and elevation of palatal mucosa before rotating the flaps and closing the defect. One flap basically fills the defect while the second flap “hugs” the first.

Pedicle mucosal flaps such as the angularis oris flap have been described using large segments of cheek tissue and buccal mucosa to repair palatal defects. The tissue is isolated, dissected and directed caudal to the maxillary second molar tooth before it is used to repair the defect. The vitality of this flap is maintained by preservation of the angularis oris artery. Because such a large segment of tissue originates from the caudal cheek, risk of occlusal trauma from teeth should be considered a risk to this procedure. This type of flap should not be used as an initial treatment option since use of the cheek tissue results in reduction of the range of motion to open the mouth.
Other advanced techniques exist for rotating haired portions of skin from the neck and head to close complicated lesions in the mouth. These techniques typically utilize the superficial cervical artery to maintain flap viability.

Island axial pattern flaps
Island axial pattern flaps operate on the premise that the tissue used for ONF closure is elevated and transposed while only being tethered to the donor location by vasculature. Island palatal flaps used for caudal oral cavity repair rely on preserving the greater palatine artery. This repair technique is particularly helpful in treating midline lesions at the junction of the hard and soft palate.

Miscellaneous ONF closure techniques
Unusual repair techniques have been reported in the literature such as creating a split-thickness incision in the tongue and suturing it to the roof to he mouth (used for cleft palate repair) and techniques creating flaps by incising and laterally sliding palatal tissue towards midline (modified Von Langenbeck technique).

As with any flap repair, careful consideration must be made for recommendations given during the post-operative period. Careful selection of the local anesthetic medications should be made to balance a comfortable post-operative period/recovery without jeopardizing self-trauma to the flap from tongue thrusting due to the repair site being numb and the patient reacting to the sutures. Short acting local anesthetic drugs (lidocaine) provide comfort during the immediate surgical period and a comfortable and quick transition to oral or transdermal medications post-operatively. Use of an e-collar may be helpful to discourage picking up inappropriate objects or engaging in rambunctious behavior. Restrictions for food should include feeding soft food in a gruel consistency. Complications with healing typically are not repaired for 6 weeks following dehiscence to allow for continued wound healing and to establish that certain aspects of the surgical repair have healed and appropriately remodeled. Consideration should be made for incomplete surgical margins (unhealthy tissue if the ONF results from an oncologic resection) or if the ONF occurred spontaneously, consideration for biopsy of the unhealed site may be wise to ensure no underlying disease processes exists.

Since tension is a major source for dehiscence, efforts to support the overlying flap can be crucial to aiding in successful healing. Periosteal releasing incisions will allow for tissue stretch. Various scaffolds have been placed between bone (hard palate) and the overlying flap. These scaffolds have included swine intestinal submucosa, bone (allograft) membranes, auricular cartilage and commercially available absorbable membranes and meshes.

Obturators

Obturators involve the use of a synthetic material created to occupy the opening connecting the oral and nasal cavities. They should rarely be considered a "first line" treatment option for the treatment of oronasal fistulas and despite being a "non-invasive" repair method. Maintenance of these devices include routine (q6 month) general anesthesia for removal and cleaning. Obturators are commonly fashioned chair side using dental impression materials and molds. Bis-acryl composite or dental acrylics are used to fabricate the obturator. Most obturators are self-retaining and are formed in the shape of a flange with a lip of material extending over the hard palate on the oral side and over the maxillary or incisive bones on the nasal side. It is important that the rigid material is trimmed and smoothed to minimize any contact ulceration or trauma to neighboring soft tissues. Obturators have also been fashioned with hooks or clips which engage screws anchored in bone (in humans) or to orthodontic buttons or hooks cemented to tooth structure. These devices offer the potential flexibility for being removable allowing for periodic cleaning.

Conclusion

A variety of causes result in ONF development; however, severe periodontal disease or iatrogenic ONF during extraction are most common. Ensuring that an underlying disease process does not undermine the healing process is an important step to achieving healing. Wide-based, tension-free closure is important for healing. Appropriate pain management and good client compliance are important during the postoperative period.

Recommended Reading:

1. Soukup JW, Snyder CJ, Gengler WR. Free auricular cartilage autograft for repair of an oronasal fistula in a dog. J Vet Dent 2009;26(2):86-95
2. Zacher AM, Marretta SM. Oral and maxillofacial surgery in dogs and cats. Vet Clin North Am Small Anim Pract 2013;43(3):609-49
3. Manfra Marretta S. Repair of acquired palatal defects. In: Verstreate FJM, Lommer M, Tswagua A (eds): Oral and Maxillofacial Surgery in Dogs and Cats. Edinburgh, UK, Elsevier Ltd., 2012, pp 363-372
4. Verstraete FJ. Mandibulectomy and maxillectomy. Vet Clin North Am Small Anim Pract 2005;35(4):1009-39
5. Bryant KJ, Moore K, McAnulty JF. Angularis oris axial pattern buccal flap for reconstruction of recurrent fistulae of the palate. Vet Surg 2003;32(2):113-9
6. Marretta SM, Grove TK, Grillo JF. Split palatal U-flap: a new technique for repair of caudal hard palate defects. J Vet Dent 1991;8(1):5-8.

WOOF, MEOW, CHILL: MAKING SENSE OF BEHAVIOR DRUGS,101

Lisa Radosta DVM, DACVB
Florida Veterinary Behavior Service
Jupiter, FL, USA
www.drlisaradosta.com
@drlisaradosta (Linked in, Instagram, YouTube, Facebook)

Why Understanding Medications Matters

- Safer prescribing practices.
- Improved confidence in treatment plans.
- Better management of client expectations.
- Increased awareness of potential side effects.
- Enhanced decision-making for effective outcomes.

How Medications Affect Behavior

- The brain functions as a network of interconnected neurons, with neurotransmitters and receptors determining the speed and impact of signals.
- Medications influence neurotransmitters and, in turn, the stress response, targeting important brain areas such as:
  - Amygdala (emotions)
  - Hippocampus (learning and memory)
  - Locus coeruleus (arousal)
  - Hypothalamus (hormonal regulation)
- Behavior medications modify the neurochemistry of the stress response, either speeding up or slowing down transmissions.

Amino Acid Neurotransmitters

- Glutamate (excitatory): Drives learning and cognition.
- GABA (inhibitory): Promotes relaxation and reduces anxiety.
- An imbalance of glutamate and GABA can lead to sedation, anxiety, hypervigilance, or cognitive deficits.
- Medications affecting GABA and glutamate:
  - Benzodiazepines (e.g., diazepam)
  - Gabapentin
  - Pregabalin
  - Supplements like Zylkene®, Anxitane®, and Solliquin®.

Benzodiazepines (BZDs)

- Amplify GABA activity to reduce fear and anxiety but can also decrease rational thought, impair memory and focus.
- Metabolized by the liver (CYP450) and excreted via kidneys.
- Accumulate in fat; avoid in pets with liver issues or high body fat.
- Use BZDs with no active metabolites for liver-compromised patients.

Gabapentin and Pregabalin

- Mechanism: Use the L-amino acid transporter; primarily excreted by the kidneys.
- Gabapentin is metabolized ~30% in the liver (dogs).
- Caution with kidney disease; higher doses do not always equate to better outcomes.

Monoamine Neurotransmitters

- Norepinephrine: Focus, energy, alertness.
- Serotonin: Emotion, mood, anxiety, pain.
- Dopamine: Reward, pleasure, motivation.
- Medications targeting monoamines: SSRIs, SARIs, SNRIs, TCAs, MAOIs.

Key Medications

- SSRIs (e.g., fluoxetine, sertraline): Block serotonin reuptake; effects take 4-6 weeks, but side effects occur immediately.
- SARIs (e.g., trazodone): Serotonin receptor antagonist/reuptake inhibitor with sedative effects; best dosed on an empty stomach.
- TCAs (e.g., Clomicalm®, amitriptyline): Broad effects; side effects include sedation, dry mouth, and urinary retention.

Prescribing Tips

- Match medications to neurotransmitter imbalances and specific behaviors.
- Avoid combining drugs with overlapping effects unless well understood.
- Monitor organ function (liver/kidneys) when prescribing medications metabolized by these systems.
- Educate clients about the timeline for effects and possible side effects.

Summary

- Understanding the neurochemical mechanisms of behavior medications improves treatment efficacy and safety.
- Always balance the desired outcomes with the health of the patient and potential side effects.

WOOF, MEOW, CHILL: MAKING SENSE OF BEHAVIOR DRUGS, PART 2

Lisa Radosta DVM, DACVB
Florida Veterinary Behavior Service
Jupiter, FL, USA
www.drlisaradosta.com
@drlisaradosta (Linked in, Instagram, YouTube, Facebook)

There are no stead and fast rules for prescribing for behavioral disorders. The guidelines below are general best practices. Sometimes you will depart from the guidelines as long as it is safe for your patient. Before prescribing always research the medication, side effects and metabolism.

Steps to Effective Prescribing

1. Decide to Prescribe
2. Choose a Dosing Schedule
3. Choose a Drug Category
4. Prescribe
5. Make Effective Medication Changes

DECIDE TO PRESCRIBE

When to Prescribe:

- Long recovery time expected.
- Quality of life (QOL) significantly impacted.
- Pet at risk of self-injury or harming others.
- Quick reaction or low threshold for arousal.
- Environment not conducive to improvement.
- Behavior moderately to severely affected.

When NOT to Prescribe

- Mildly affected behaviors.
- Environment conducive to success.
- Low risk to the pet or others.
- High threshold for reaction/arousal.
- Little to no effect on QOL.
- Immediate recovery likely.

Choose a Dosing Schedule

- Daily Dosing: Use for long-term stabilization.
- Non-urgent cases/PRN (As Needed):Use for acute, predictable, or urgent scenarios.
- Most anxiety disorders benefit from PRN treatment.
- Combination of PRN and Daily: Common in cases like separation distress.

PRN Dosing Timeline

- Week 1: Start low, assess response.
- Weeks 2–4: Increase dose or try another medication if needed.
- Long-term: Adjust based on progress, wean as appropriate.

Choose a Drug Category

- Supplements: Use for mild cases or as adjuncts to PRN medication.
- Examples: L-theanine (5–10 mg/kg PO BID). Magnolia officinalis/Phellodendron amurense (15–30 mg/kg PO SID).
- Medications: Appropriate for moderate to severe cases or at-risk pets.
- Categories: benzodiazepines, gabapentin/pregabalin, clomipramine (Clomicalm®), fluoxetine (Reconcile®), trazodone, clonidine, Sileo®, acepromazine.

Prescribe

- Base decisions on:
- Clinical Signs: (e.g., destruction, urination, defecation).
- Desired Outcomes: Reduced stress, improved behavior.
- Latency and Duration: How quickly the drug acts and how long it lasts.
- Examples of outcomes and drug options:
- Decreased stress and destruction: trazodone, gabapentin, Sileo®.
- Relaxation and sedation: benzodiazepines (e.g., diazepam, clorazepate).

Tips:

- Start low and increase as needed.
- Do not rely solely on diagnosis—focus on clinical signs and goals.

Make Effective Medication Changes

- Apply the 50% Rule:
- If signs improve by ≥50% with no side effects, continue or increase dose if safe to do so.
- If <50% improvement, consider adding another medication or switching drugs if safe to do so.
- Monitor side effects and adjust dosing or medication as needed.

Key Medications Overview

- Benzodiazepines: Amplify GABA; reduce fear and anxiety.
  - Examples:diazepam, alprazolam, clorazepate.
  - Onset and duration vary; select based on case.
- Gabapentin/Pregabalin: Reduce fear and aggression.
  - Excreted through kidneys; use caution in renal-compromised pets.

- Trazodone: Sedative with serotonin modulation; best given on an empty stomach.
- Clomicalm® (Clomipramine): TCA with broad effects; potential for sedation and GI upset.
- Serotonergic Medications: Improve calmness, reduce fear, and manage aggression.

Other considerations

- Behavioral Supplements: May support mild cases or complement medications.
- Client Communication: Educate owners on realistic outcomes and timelines for improvement.

ACHES AND ATTITUDES: HOW PAIN AND DISEASE SHAPE CANINE BEHAVIOR

Lisa Radosta DVM, DACVB
www.drlisaradosta.com
@drlisaradosta (Linked in, Instagram, YouTube, Facebook)

Understanding Behavioral Problems

- Phenotype: Observable behaviors influenced by genetics, environment, and emotional state.
- Behavior Changes: Reflect a combination of intrinsic (e.g., genetics, health) and extrinsic factors (e.g., environment, social interactions).
- Pain as a Driver of Behavior:
- Dogs with underlying pain are more likely to exhibit aggression, fear, and anxiety.
- Studies show 23–82% of dogs with behavioral issues have a medical condition contributing to their behavior.

Pain and Behavior

- Definition of Pain: An unpleasant sensory and emotional experience related to actual or potential tissue damage.
- Includes emotional and perceptual components.

Specific Behavioral Connections

- Orthopedic Pain: Dogs with joint or skeletal issues often display behavioral changes (e.g., aggression, hypervigilance).
    i. Example: Hip dysplasia causing defensive aggression.
- Noise Phobia and Pain: Dogs with musculoskeletal pain and noise phobia often present at older ages (average 6.5 years).
    i. Pain exacerbates fear responses to noises.
- Dermatologic Pain: Dogs with atopic dermatitis exhibit increased anxiety, stress, aggression, and hyperactivity.
    i. Skin discomfort reduces coping abilities, increasing irritability.
- Gastrointestinal (GI) Pain: Licking behaviors may indicate underlying GI disease.
    i. Example: Excessive licking resolved in 59% of cases with proper GI treatment.

Clinical Action Steps

- **Pain Assessment**: Conduct no-touch physical exams for aggressive or reactive dogs. Evaluate for asymmetry, changes in form, or function.
- **Run Appropriate Diagnostics**: Labwork: CBC, chemistry, GI panels, and imaging as needed.
- **Address Motion Sickness**: Treat as a factor in car-related fear or anxiety.
- Dosage: 8 mg/kg PO, 2 hours before travel on an empty stomach.

- **Treat for Treatable Conditions**: Provide targeted therapy for diagnosed conditions (e.g., orthopedic, GI, dermatologic).

Practical Takeaways

- Pain Is Perceived Individually:
- Only the patient knows their pain level.
- Extrinsic behaviors (licking, posture) provide valuable diagnostic clues.
- Behavioral Changes Require a Holistic Approach.
- Treat physical and emotional components together.
- Use medications and behavioral modifications for optimal results.

Conclusion

- Pain often underlies or exacerbates behavioral issues in dogs.
- Assess, diagnose, and treat pain systematically to improve outcomes for both the pet and the owner.
- Use a combination of diagnostics, medications, and environmental management to address behavior holistically.

SIBLING SHOWDOWN: NAVIGATING INTERDOG AGGRESSION IN THE SAME HOUSEHOLD

Lisa Radosta DVM, DACVB
www.drlisaradosta.com
@drlisaradosta (Linked in, Instagram, YouTube, Facebook)

Understanding Inter-Dog Aggression

- Aggression often occurs between housemate dogs, especially in same-sex pairings:
  - 62–79% of cases involve same-sex pairs, with females being the most common.
- Common Instigators:
  - Younger dogs (74% of cases).
  - Newer dogs in the household (59–70%).
- Behavioral comorbidities (42%).
  - Incompatible or fearful temperaments (54%).

Why Dogs Fight

- Over Resources (73%): Food, toys, or attention.
- Attention Seeking (21–46%): Competing for the owner's focus.
- Overstimulation (31–35%): High arousal during play or excitement.
- Tight Spaces (18%): Conflicts occur in doorways or confined areas.
- Stressful Environments: Loud noises, busy households, or routine disruptions.
- Illness: Pain or underlying medical conditions.
- Unknown Reasons (13%): Triggers are not always identifiable.

Negative Prognostic Indicators

- Instigating dog is younger than the target.
- Aggression occurs on sight of the recipient.
- A person has been bitten during an altercation.
- Same-sex pairings, especially females.
- No clear trigger identified for the aggression.

Spectrum of Care Approach

1. Rehome
2. Permanent use of crates, gates, or separate areas. Medications may be used for long-term management.
3. Partial Reintroduction: Use crate, gate, and separate techniques. De-escalate the environment. Combine with medications and behavior modification for 2-3 months.
4. Full Reintroduction: Gradual integration over 2–6 months. Both dogs on medications during the process. Ongoing behavior modification efforts.

Treatment Success

- 59–69% of cases improve with treatment.
- 56% of dogs can be left unsupervised after successful interventions.
- Relapses are common and require ongoing management.

Management Strategies

- Immediate Actions:
  - Separate dogs if fights result in injuries requiring medical attention.
  - Avoid letting dogs “work it out” themselves—this often leads to escalation.
- Training and Structure:
  - Create consistent routines and rules to reduce stress.
  - Don’t get caught up on pack hierarchy/dominance. Not linked to changes in outcomes.
- Medications:
  - Medicate both dogs if fights cause injuries is frequent or is escalalting.

Key Takeaways

- Dogs rarely resolve conflicts without intervention.
- Owners should avoid situations where fights could occur (e.g., sharing resources).
- Crate, gate, and separation strategies can reduce conflict during the cooling-off period.
- Behavioral and environmental modifications combined with medications increase success rates.

TIPS, TRICKS, AND HACKS: THE ESSENTIAL GUIDE TO FELINE AGGRESSION

Lisa Radosta DVM, DACVB
www.drlisaradosta.com
@drlisaradosta (Linked in, Instagram, YouTube, Facebook)

Key Facts About Feline Aggression

- Prevalence:
  - 400,000 cat bites and 66,000 ER visits annually in the U.S.
  - Aggression prevalence in cats ranges from 36–69%, with 50% of bites directed at family members.
- Triggers:
  - Stress, illness, genetics, and life experiences are significant contributors.
  - Many cat owners misinterpret or miss early warning signs of aggression.

Understanding Feline Behavior

- Normal Cat Social Dynamics:
  - Females live in colonies of related individuals, while unrelated cats are excluded.
  - Domestic settings often force unrelated cats to live together, creating tension due to resource competition and lack of space.
- Communication Challenges:
  - Pet parents often misunderstand feline body language.
  - Subtle aggression signs (e.g., posturing, staring) can escalate if missed.

Common Types of Aggression

- Play-Induced Biting:
  - Stalking, play postures, and excessive biting during interaction.
- Fear-Induced Aggression:
  - Signs include dilated pupils, piloerection, and attempts to flee or fight.
- Frustration-Induced Aggression:
  - Triggered by petting, picking up, or physical restraint.
  - Signs include tail thumping, excessive panniculus, ear rotation, and vocalization.
- Redirected Aggression:
  - Aggression directed at a victim other than the initial trigger (e.g., another pet or person).
  - Often severe and difficult to interrupt; association between trigger and aggression can become permanent.

Diagnosis and Treatment Overview

- Use a history questionnaire and encourage pet parents to describe behaviors in detail.

- Perform diagnostics: CBC, chemistry, T4, ProBNP, urinalysis, fecal antigen test.
- Categorize aggression as clinical signs, motivational, or descriptive.
- Treatment Modalities:
  - Environmental Changes:
  - Increase space and access to resources (e.g., food, water, litter boxes, perches).
  - Use multimodal environmental modifications (MEMO) to reduce stress.
- Behavioral Treatments:
  - Gradual desensitization and counterconditioning.
  - Encourage "go to your spot" training.
- Reduce Neurochemical Stress:
  - Supplements (e.g., Solliquin®, Zylkene®, Anxitane®) for mild cases or comorbidities.
  - Medications (e.g., SSRIs, TCAs, benzodiazepines, trazodone) for moderate to severe aggression.

Medication Tips

- When to Prescribe:
  - When aggression affects welfare, quality of life, or safety.
  - For moderate to severe aggression or urgent cases.
- Common Options:
  - Quick Onset: Benzodiazepines, trazodone, clonidine, gabapentin, pregabalin, Sileo®.
- Long Onset: SSRIs (fluoxetine, Reconcile®), TCAs (amitriptyline), supplements like Solliquin® or Anxitane®.
- Administration Considerations:
  - Caution with transdermal antidepressants due to inconsistent absorption.
  - Match the medication to the patient's behavior, needs, and severity.

Talking to Pet Parents

- Set Realistic Expectations:
  - Explain that aggression is a normal response to certain stimuli.
  - 50% of cats fight when first introduced; 39% still fight weekly a year later.
  - Long-term improvement often requires 6–12 months of treatment.
- Discuss Safety:
  - Both cats in cases of inter-cat aggression need treatment.
  - Separate cats if safety cannot be assured.
- Educate About Environmental Needs:
  - Proper enrichment (visual, auditory, olfactory, gustatory, structural) reduces stress.
  - Use pheromone analogues (e.g., Feliway®) to create a calming environment.

When to Refer

- Consider referral for:
  - Deep bites, severe aggression, or high-risk cases (e.g., children or elderly in the home).
  - Little improvement despite treatment.
  - Complex cases involving polypharmacy or multiple behavioral diagnoses.

Takeaways for Veterinary Teams

- Behavioral aggression is multifactorial: Address medical, environmental, and emotional components.
- Treat aggressively when the patient is at risk or quality of life is severely impacted.
- Environmental modifications are foundational and often effective in combination with medication.
- Refer complex cases to a board-certified veterinary behaviorist and a positive-reinforcement cat trainer.

DOG AND CAT ANXIETY 101: FIND IT, TREAT IT, BE SUCCESSFUL!

Lisa Radosta DVM, DACVB
www.drlisaradosta.com
@drlisaradosta (Linked in, Instagram, YouTube, Facebook)

Understanding Anxiety, Fear, Phobia, and Stress

- Anxiety: Anticipation of a threat even when the stimulus is not present.
- Phobia: An out-of-context, exaggerated fear response that includes panic.
- Stress Response: Activates the hypothalamic-pituitary-adrenal (HPA) axis, leading to physiological changes like tachycardia, hyperthermia, and cortisol release.

Clinical Signs of Anxiety

- Behavioral: Refusal to walk, aggression, excessive vocalization, or attempts to escape.
- Physical: Panting, pacing, trembling, hyperthermia.
- Environmental interactions: Destruction, house soiling, hiding.

Common Anxiety Disorders

- Noise Aversion:
  - Affects 49% of dogs; often underreported (19% recognized by owners).
- Triggers: Fireworks, thunderstorms, traffic, construction.
- Separation-Related Disorders:
  - Symptoms: Pacing, howling, destruction, urination, defecation.
  - May include “real” or “perceived” absence of the owner.
- Pain-Associated Anxiety:
  - 60% of behavior cases involve undiagnosed orthopedic pain.
  - Pain prolongs the onset of noise sensitivities (e.g., from 2.5 to 6.5 years).

Steps to Diagnosis

- Gather a thorough history:
- Use videos, timelines, and descriptions to identify patterns.
- Consider systemic diseases that may mimic or exacerbate anxiety.
- Perform a complete health check:
- Dogs: CBC, chemistry, fT4 (ED), urinalysis, fecal tests.
- Cats: Add T4, ProBNP, and Giardia antigen testing.

Five Steps to Effective Prescribing

- Prescribe if:
  - Removery is prolonged.
  - Quality of life (QOL) is impacted.
  - There is risk of self-injury or harm to others.
  - The patient shows moderate to severe symptoms.

- Choose a Dosing Schedule:
  - Daily medications for long-term stabilization.
  - PRN (as-needed) for acute, predictable events (e.g., fireworks).
  - Most cases require a combination of PRN and daily medications.
- Select a Medication Category:
  - Quick Onset vs Daily Medications vs Supplements
- Prescribe and Adjust:
  - Start low and titrate up, based on clinical response.
  - Adjust dose or add medications using the 50% Rule:
- Evaluate and Reassess:
  - Recheck every 2–3 weeks.
  - Expect to make several medication adjustments.

Behavioral and Management Strategies

- Environmental Modifications:
  - Provide hiding spaces, cover windows, and use calming music.
  - Use pheromones (Adaptil, Feliway®) for additional calming effects.
- Behavioral Modification:
  - Work with a positive reinforcement trainer or technician.
  - Techniques include desensitization, counterconditioning, and relaxation training.
- Management Tools:
  - Avoid triggers when possible.
  - Provide alternatives such as dog daycare, pet sitters, or structured walks.

Key Takeaways for Pet Owners

- Stay calm and consistent.
- Reinforce desirable behaviors and avoid punishment.
- Understand that behavioral improvement requires time, commitment, and adjustments.

SNIP DECISIONS: TIMING SPAYS AND NEUTERS RIGHT

Lisa Radosta DVM, DACVB
www.drlisaradosta.com
@drlisaradosta (Linked in, Instagram, YouTube, Facebook)

The decision to spay or neuter a pet is not straightforward. It is an individual decision that must be discussed between the pet parent and the veterinarian, considering the breed, age, risk of unwanted pregnancy or fathering of puppies, and risk of disease. I have tried to simplify the risks and benefits below however, it's imperative that the reader understand that the conclusions of one individual study may not apply to all individual dogs.

Introduction-Gonadectomy and Behavior:

- Increased risk of noise aversion, fear, and aggression in gonadectomized dogs.
- Spayed females and neutered males are more likely to display fear-related behaviors compared to intact dogs.
- Early gonadectomy (<6 months) is associated with:
  - Increased likelihood of aggression and fear of noises.
  - Lower incidence of separation anxiety.
  - Late gonadectomy (>18 months) can still contribute to increased aggression.

Behavioral Changes in Spayed/Neutered Dogs

- Improved Behaviors:
  - Reduced roaming, urine marking, and sexual behaviors in neutered males.
  - Decreased likelihood of separation anxiety in females spayed before 5.5 months.
  - Early gonadectomy reduced inappropriate elimination and separation anxiety.
  - Spayed dogs had increased fear of sounds and unfamiliar objects compared to intact dogs.
  - Delayed spaying until after 18 months reduced aggression risks.
  - Intact females outperformed spayed females in learning and problem-solving tasks.
- Negative Changes:
  - Increased barking, fear, and aggression toward people and other dogs in spayed females.
  - Spayed Labrador Retrievers exhibit more frequent and intense fear reactions to unfamiliar objects and noises.
  - Dogs spayed/neutered <6 months had higher rates of fear-related disorders.
  - Dogs spayed before 12 months were more likely to exhibit aggression.

Clinical Recommendations

- Assess the individual dog's behavior, medical history, and environment before recommending gonadectomy.
- Consider delaying spaying/neutering in breeds or individuals predisposed to fear and aggression.
- Discuss possible behavioral changes associated with spaying/neutering.
- Explain that behaviors are multifactorial and not solely related to hormones.
- For dogs with severe sexual behaviors or roaming tendencies, gonadectomy may be beneficial.
- Avoid early gonadectomy (<6 months) for dogs with existing fear or aggression issues.

Spaying and neutering can have significant behavioral and medical implications. Each case requires careful consideration to optimize outcomes for both the pet and the family.

BEHAVIORAL MEDS QUICK GUIDE: EXPERT TIPS FOR VETERINARY PROFESSIONALS

Lisa Radosta DVM, DACVB
www.drlisaradosta.com
@drlisaradosta (Linked in, Instagram, YouTube, Facebook)

Awareness of When to Prescribe
Medications are not a last resort. Using stress-reducing medications should be a first line for patients who may need them.

Key Indicators for Medication Use:

1. The pet or pet parent's quality of life is significantly impacted.
2. Suffering may be alleviated with behavior medications.

Considerations Before Prescribing:

- **Time to recovery:** Long recovery justifies prescribing; short recovery may not.
- **Quality of life:** Prescribe if poor.
- **Environment:** Is the home conducive to behavioral improvement? If not, consider medications.
- **Risk factors:** Prescribe if the pet poses a risk to itself or others.
- **Behavior predictability:** Unpredictable behaviors may require medication, although as needed, medications may be needed for predictable behaviors.
- **Severity:** Moderate to severe behaviors often benefit from medications.
- **Latency to arousal:** Short latency may necessitate medication.

Prescribing Hacks

1. General Tips:
    a. Start with the lowest dose and titrate as needed.
    b. In emergencies, prioritize immediate symptom relief over gradual dosing.
    c. Base decisions on clinical signs and treatment goals, not solely diagnosis.
2. Clinical Focus:

a. Identify specific behaviors (e.g., destruction, urination, defecation, anxious behavior).

b. Align medication choices with desired outcomes (e.g., reducing stress or destruction).

Common Medications:

- **Short-acting options:** Benzodiazepines, gabapentin, trazodone, clonidine, Sileo®, acepromazine.
- **Long-acting options:** Clomicalm®, Reconcile®.
- **Supplements:** L-theanine, magnolia/phellodendron blends, alpha-casozepine.

Managing Client Expectations

- Medications are not a cure-all; they often require dose adjustments over time.
- Most behavior cases will need a short-acting medication at some point.
- Instruct clients to test medications at home and monitor effects (e.g., sedation, appetite changes).
- Educate clients about potential side effects (e.g., vomiting, diarrhea, paradoxical excitement).

Thoughtful Prescribing

- **Short-acting ("PRN") Medications:** Use in emergencies, predictable stimuli, or immediate care situations. Consider onset and duration of action for specific situations.
- **Long-acting Medications:** Appropriate for chronic behavioral support. Factor in patient health, dietary restrictions, and required medication effects.

Dosage Adjustments

- Follow the "50% Rule
- Consider combination therapy if improvement plateaus.
- Use online drug interaction checkers when combining medications.
- Avoid combining medications that act on the same neurotransmitter unless confident.

Common Medication Combinations

- **Reasonable Pairings:**
    - Trazodone + Clomicalm® OR Reconcile®
    - Gabapentin OR pregabalin + Clomicalm® OR Reconcile®
    - Clonidine + Clomicalm® OR Reconcile®
- **Avoid Combinations:**
    - Clomicalm® and Reconcile®
    - Clonidine, acepromazine, and/or Sileo®

PRN Medication Dosing Timelines

- **Before Triggering Events:**
    - Sileo®: 30–45 minutes prior.
    - Acepromazine: 4 hours prior.
    - Benzodiazepines, clonidine, gabapentin, trazodone: 3 hours prior.

Key Takeaways

- Prioritize the health and quality of life of the pet.
- Collaborate with clients to manage expectations and ensure adherence.
- Stay mindful of potential side effects and drug interactions.
- Behavior medications are tools, not magic fixes—adjustments are part of the process.

For more resources, visit **www.flvetbehavior.com** or **www.drlisaradosta.com**.

PURRPLEXED: UNCOVERING THE LINK BETWEEN DISCOMFORT AND CAT BEHAVIOR

Lisa Radosta DVM, DACVB
www.drlisaradosta.com
@drlisaradosta (Linked in, Instagram, YouTube, Facebook)

I. Introduction

- Behavior is the sum of environment, health, genetics, and coping skills.
- When coping is possible → relaxed cat.
- Pain/discomfort undermines coping → drives behavior change.

II. Behavior and Health: The Iterative Cycle

- Behavior is influenced by:
  - Social & physical environment
  - Psychological health
  - Physical health
- Cycle of learning & coping style reinforces or worsens behavior.
- Clinical question: Should medical disorders be ruled out before treating behavior?
  - Concerns: interfering with diagnostics, worsening behavior, treating without diagnosis.
  - Key point: Medications can alleviate suffering while pursuing diagnosis; most are safe when dosed correctly.

III. Prevalence of Pain in Cats

- **Osteoarthritis (OA) prevalence**
  - Lascelles 2010: 92% of cats (0–20 yrs) had OA in ≥1 joint.
  - Hardie 2002: 90% of cats (<12 yrs) OA in ≥1 joint; 55% multiple joints.
  - Godfrey 2005; Slingerland 2011: 22–61% prevalence depending on age/sample.
- **Diagnostic challenge:**
  - Sensitivity vs specificity of detecting pain.
  - Owners underreport (only 13% noticed lameness despite 61% OA on radiographs).

IV. Clinical Signs of Pain/Discomfort

- **Behavioral indicators** (Lascelles, Asproni, Palmeira, Robertson):
  - Dilated pupils, lip licking, vocalization, changes in activity, respiratory/vomeronasal signs.

- **Common behavior-linked conditions:**
  - Aggression
  - Overgrooming
  - Changes in interactions or appetite
  - Periuria/perichezia

V. Declawing and Behavior

- Martell-Moran 2017 study:
  - Declawed cats more likely to have pain & behavior issues.
  - 3x more back pain, 7x more periuria, 4.5x more likely to bite, 3x more overgrooming.
  - 63% had retained P3 fragments → worsened outcomes (up to 9x aggression).

VI. Specific Conditions Linking Discomfort and Behavior

1. Periuria

- Sometimes linked to spinal pain (L4–S2).

2. Gut-Brain Axis

- Nervous, endocrine, immune systems interconnected.
- Microbiome influences neurotransmitters (monoamine precursors, GABA).
- Stress ↔ microbiome relationship.
- Altered microbiome associated with behavioral changes.

3. Pica

- Fabric ingestion associated with gastric reflux & delayed gastric emptying.
- Case example:
  - Ravenous appetite, vomiting/diarrhea, foreign body removal.
  - Workup: GI panel, fecal, T4, nutritionist referral.
  - Management: fluoxetine trial, home-cooked diet → “1000% better.”

4. Psychogenic Alopecia

- Often misdiagnosed as purely behavioral.
- 80% of referred cases actually had dermatologic disease.
- Case examples:
  - Allergy testing, dietary management, multiple medication trials.
  - Final resolution with dermatology + multimodal therapy (Atopica, gabapentin, antihistamines).

- **Key message:** *This is not behavioral.* Underlying medical causes must be ruled out.

VII. Key Clinical Takeaways

- Pain and discomfort are highly prevalent but underdiagnosed in cats.
- Behavioral changes (aggression, periuria, overgrooming, pica) often signal medical issues.
- Pet parents underrecognize pain signs—veterinarians must lead.
- Multimodal approach: medical workup + behavior support.
- Do not default to “psychogenic” without excluding discomfort.

PAWPULAR POPPERS: MEDS FOR VET VISITS

Lisa Radosta DVM, DACVB
www.drlisaradosta.com
@drlisaradosta (Linked in, Instagram, YouTube, Facebook)

The notes below are a general overview. Always look up every medication that you prescribe. Make sure that you know the metabolism in the species that you are prescribing for and any side effects/interactions.

Approach to Decision-Making

- Clinical Signs:
  - Identify fear, anxiety, and stress (FAS).
  - Assess associated behaviors (e.g., destruction, vocalization, aggression).
- Desired Outcome:
  - Examples:
    - Decreased stress, anxiety, and fear.
    - Increased sociability, calmness, or appetite.
- Medication Effects:
  - Match drug choice with clinical signs and desired outcomes.
  - Adjust dose or dosing schedule as needed to achieve >50% improvement.

Key Medications for FAS

- Benzodiazepines (BZDs):
  - Examples: alprazolam, diazepam, lorazepam, clorazepate, clonazepam.
  - Target Effects: Sedation, decreased fear, increased sociability, and appetite.
  - Onset & Duration: Onset: 30–60 minutes (depending on the specific drug).
  - Duration: 4–8 hours.
  - Side Effects: Sedation, ataxia, paradoxical excitement, amnesia, and GI upset.
  - Use Cases: Short-term relief for vet visits, car rides, or acute stressors.
- Gabapentin:
  - Target Effects: Sedation, decreased anxiety, pain relief, anticonvulsant effects.
  - Onset & Duration: Onset: 1–2 hours.
  - Duration: 6–8 hours.
  - Side Effects: Sedation, ataxia, increased appetite, and GI upset.
  - Use Cases: Ideal for mild to moderate anxiety or fear.
- Trazodone:
  - Category: Serotonin antagonist and reuptake inhibitor (SARI).
  - Target Effects: Sedation, calming effects.
  - Onset & Duration: Onset: 1–3 hours.
  - Duration: 6–8 hours.

    - Side Effects: Sedation, agitation, appetite changes, and GI upset.
    - Use Cases: Short-term use for predictable stressors, such as vet visits or grooming.
- Acepromazine:
    - Category: Phenothiazine sedative.
    - Target Effects: Sedation and calming effects.
    - Onset & Duration: Onset: 1–2 hours.
    - Duration: 8–12 hours.
    - Side Effects: Sedation, increased sensitivity to sound, startle response, and ataxia.
    - Use Cases: Reserved for cases where strong sedation is necessary. Use with an anti-anxiety medication.
- Clonidine & Sileo® (Dexmedetomidine):
    - Category: Alpha-2 agonists.
    - Target Effects: Sedation, decreased sympathetic nervous system (SNS) response, and hypervigilance.
    - Onset & Duration:
        - Sileo®: Onset 20–40 minutes.
        - Clonidine: Onset 1–2 hours; Duration 4-6 hours.
    - Side Effects: Sedation, incontinence, decreased appetite, and GI upset.
    - Use Cases: Immediate stress reduction during vet visits or acute events.

Dosing Guidelines

- Start with the lowest effective dose and titrate as needed.
- Apply the 50% Rule:

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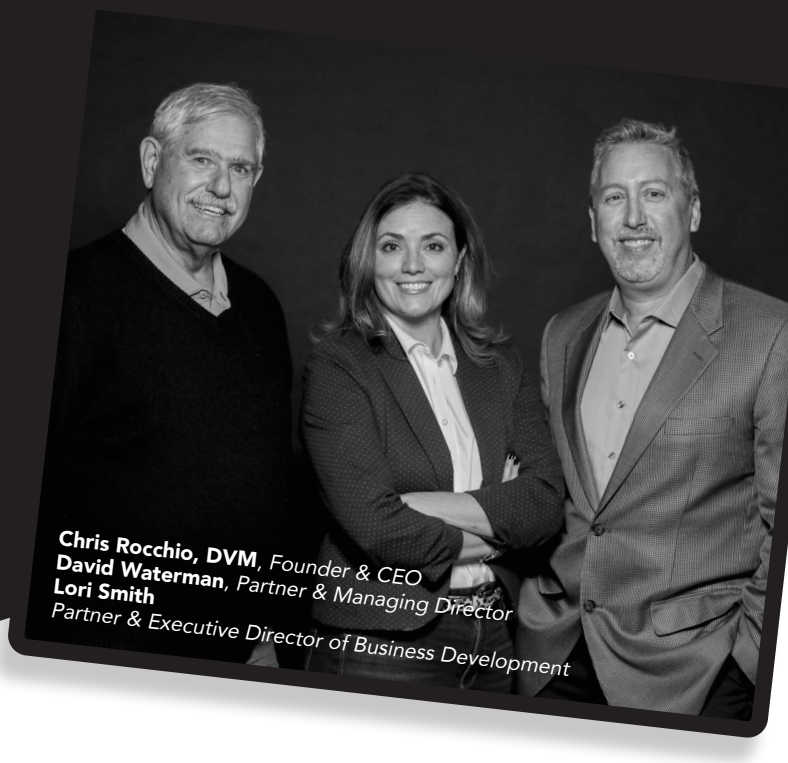

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