

Common Mistakes in Veterinary Dentistry

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1. **Fractured/Retained Tooth Roots:** Retained roots or root tips may be present for multiple reasons, including iatrogenic fracture during extraction, pathologic fracture from dental disease, traumatic crown/root fracture. If fracture occurs during extraction of a tooth, then in most cases the retained portion of the tooth root should be pursued and extracted completely. If there was previous evidence of advanced periodontal or endodontic disease, then the retained root will serve as a nidus for infection and become a chronic problem until it is removed. If there is evidence of existing tooth resorption, then retention of a tooth root may be appropriate based on the type of tooth resorption present. In general, teeth affected by Type 1 tooth resorption, where the crown or neck of the tooth is affected by a resorptive lesion but the tooth roots are largely unaffected, should be extracted completely. If the tooth is affected by Type 2 tooth resorption, where the normal root structure is being resorbed and replaced by bone and there is loss of a normal periodontal ligament space, then crown amputation with intentional root retention may be appropriate if the following are all true: no vertical alveolar bone loss due to periodontal disease, no radiographic evidence of periodical bone loss or pulp necrosis, and the patient is not suffering from stomatitis. Predictably, attempted extraction of teeth with Type 2 tooth resorption will usually result in fracture of the root. In most cases, the decision for whether it is appropriate to leave a tooth root or root tip should be made based on the dental radiographs and prior to the root actually breaking. Another complication that could occur during an extraction procedure is displacement of a root tip into the nasal cavity or mandibular canal. In most cases, the displaced root tip will not have travelled far from its original location and it can be retrieved by additional bone removal and exposure of the area.
2. **Fractured/Discolored Teeth:** Fractured teeth are the most common type of dental trauma in dogs. Causes of tooth fractures may be the result of external forces or aggressive chewing of hard objects. Fractures that expose the pulp cavity require immediate endodontic treatment or extraction. Factors that will influence the optimal treatment plan are based on the nature of the fracture, the age of the pet, and the duration of time since the injury. Owner commitment should also be considered in the decision making process. If owners are committed to saving the teeth, then a good knowledge of treatment options is important. Older patients with fully erupted and matured teeth that are fractured with pulp exposure should receive a root canal procedure as soon as possible to prevent infection and periapical abscessation of the affected tooth. Chronically fractured teeth that have large periapical abscesses or are undergoing root resorption are not good candidates for root canal therapy and extraction should be considered. Younger patients (<18 months) with open apices or immature teeth that are fractured should receive a vital pulp therapy (VPT) if they are presented within 48 hours of the injury. This treatment will allow for maintained vitality of the tooth and continued maturation of the dentin. In addition, this treatment option should provide the best cosmesis and return to normal function, especially when dealing with strategic teeth. Younger patients that present more than 48 hours after the injury occurred should be considered for other treatment options (standard root canal, apexification, or extraction). Damage to the tooth pulp can occur with trauma to the teeth.

Pulpitis, with or without pulpal hemorrhage, is usually irreversible because the inflammation occurs within the confined space of the pulp canal. Irreversible pulpitis will usually result in pulp necrosis and tooth death because of disruption of the blood supply to the tooth. Hemorrhage within the pulp results in extravasation of red blood cells and subsequent cell lysis. Hemoglobin breakdown products, including hematin, hemoxyhematin, and hemosiderin, enter the dentinal tubules and enamel resulting in the discoloration that is seen clinically. Initially, the tooth may appear pink in color but then usually turns bluish-gray followed by a grayish color that may persist indefinitely. Pulpal hemorrhage may then lead to pulp necrosis. Published data (Hale FA, 2001) has shown that over 90% of discolored teeth in dogs have partial or total pulp necrosis. Pulp necrosis is a histologic condition of the pulp that may be total or partial and the pulp may be liquefied or coagulated. This condition is usually asymptomatic if total necrosis occurs. Periapical periodontitis may develop following pulp necrosis. Anaerobic bacteria and bacterial toxins colonize the necrotic pulp because no host defense mechanisms are present within the devitalized pulp. These bacterial toxins then escape through the apex of the tooth root and cause an inflammatory response in the periodontal ligament. Periapical periodontitis and abscessation can occur as a result. Radiographic evidence of this process may occur in as little as 2-3 weeks following pulp death. Treatment of discolored teeth is needed to prevent these problems. In the study mentioned above, about half of the teeth that were known to have partial or total pulp necrosis had no radiographic evidence that such a process was occurring. Therefore, it cannot be assumed that a discolored tooth is not, or will not, cause any problems for the patient. Standard root canal therapy or extraction of the tooth should be recommended by the practitioner.

3. Oronasal Fistula: A more correct term for this problem may be oronasal "communication". This occurs where there is a communication between the mouth and the nose. This communication may be congenital (in the form of a secondary cleft palate, for example) or acquired (in the case of a deep periodontal pocket). The most common location for a naturally occurring oronasal communication is on the palatal aspect of the maxillary canine teeth in dogs. In particular, Dachshunds are notorious for having deep periodontal pockets develop in this area and the reasons are unknown. When a periodontal pocket develops in this location, the bone loss may occur through the bone into the nasal cavity. This can easily be diagnosed using a periodontal probe. Typically, patients will have presented with a history of chronic sneezing or nasal discharge and bleeding from the nose may occur when the are is probed during the oral examination. When such a communication exists, the only treatment option is extraction of the tooth. In many of these cases, the maxillary canines may appear to be in good health when only viewed from the buccal aspect of the tooth, which emphasizes the importance of periodontal probing. The most common complication following extraction of the maxillary canine may be development of a chronic oronasal fistula (or communication) at the site of the missing tooth. If an oronasal fistula does occur, it is most likely the result of poor technique with the flap development and closure on the part of the oral surgeon. The two keys to closing the flap in way that will prevent oronasal fistula formation are tension-free closure and debridement of epithelial margins. When oronasal fistulas develop, epithelial tissue will line the fistula. When epithelial surfaces are sutured together, they do not heal (any more than your hands would heal together if you tied them to one another). Prior to flap closure it is imperative that the margins of the oronasal fistula be derided to expose a bleeding, cut tissue surface and that the flap be elevated and mobilized so that it can be closed without tension. If these two principles are adhered to, oronasal fistula development should not occur at the site of extraction of a maxillary canine tooth.

4. Iatrogenic Jaw Fracture: This is potentially the most serious complication that can occur when doing oral surgery and, in particular, surgical extraction of teeth in the mandible. Extraction of the mandibular canines in dogs and cats and the mandibular first molars in dogs are the two most likely areas where an iatrogenic jaw fracture may occur. The risk of this complication can be minimized if good surgical extraction principles are kept. Adequate visualization of the tooth being extracted is performed by developing an appropriate mucoperiosteal flap. Elevating the periosteum and soft tissue off the bone allows visualization of the alveolar bone over the tooth root(s). Sectioning of multi-rooted teeth, such as a mandibular first molar, will allow for a reduction in torquing forces applied to the tooth for extraction. Appropriate, but judicious, removal of alveolar bone will release some of the attachment of a tooth root, facilitating removal. Even if a tooth seems quite diseased, the practitioner should resist the urge to simply "pull" the tooth out without at least elevating a flap, sectioning a multi-rooted tooth, and possibly removing at least a little alveolar bone. Should an iatrogenic jaw fracture occur, the owner should be notified. Ideally, the risks of surgical extractions and complications had been previously discussed with the owner. If the practitioner is comfortable with principles and techniques, then he/she may wish to proceed with a fracture repair procedure. However, if the practitioner is uncomfortable with such a procedure, or the owner specifically requests, the patient may be referred to a dental specialist for repair. If referral is planned, then x-rays confirming the fracture should be performed and any remaining teeth in the area where the fracture occurred should be left in place, as they may be useful for the specialist during the repair procedure.

Oral Tumor Management for the General Practitioner

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Oral tumors are a significant and important aspect of managing oral health in dogs and cats. It is important for the primary care veterinarian to be comfortable with initial tumor diagnosis and management. In some cases, even a “bad” diagnosis may not necessarily equate to a bad prognosis. Even some malignant tumors may have a good prognosis if properly managed. In dogs, about half of all oral tumors are benign and about half are malignant. In cats, at least two-thirds of all oral tumors are squamous cell carcinoma and oral tumors comprise about 10% of all neoplasms. In general, most oral tumors will be identified in senior or geriatric patients although a few, such as papillary squamous cell carcinoma, have been seen in dogs less than 6 months of age.

It seems obvious, but initial tumor diagnosis begins in the exam room with a complete physical examination which includes an oral examination on the conscious patient. There are some characteristics of oral tumors that have some predictive value for whether a mass will be benign or malignant. First of all, true neoplasms should be distinguished from other oral conditions that may appear as oral masses. For example, gingival enlargement that is generalized and progresses slowly is more likely to be gingival hyperplasia, which may be breed related or drug induced. Conversely, a localized area of gingival enlargement may represent an oral neoplasm, albeit benign. Typically, benign tumors are more slow growing than malignant tumors. Benign tumors also tend to have more clearly defined margins. Malignant tumors tend to be more infiltrative and the margins between normal and abnormal tissue are less clearly defined grossly and/or radiographically. The more common types of malignant oral tumors will also increase in size more rapidly than benign tumors. One interesting characteristic of oral tumors is their effect on adjacent teeth. Benign tumors are more likely to displace teeth out of their normal position, whereas malignant tumors may affect the tissues around the teeth without displacing them, resulting in mobile teeth that are mostly in a normal position in the mouth. This is one example of how a tumor may look worse than it is if the mass has shifted the dentition out of a normal anatomic position.

The primary difference in malignant and benign neoplasms is whether they can metastasize or not. Oral malignancies metastasize at different rates and may result in either regional or distant metastasis. The most likely malignant oral tumors in dogs (in order from most common to least common) are: malignant melanoma, squamous cell carcinoma, fibrosarcoma, and osteosarcoma. In cats, squamous cell carcinoma is by far the most common malignant oral tumor, although fibrosarcoma and osteosarcoma are also seen. The most common types of benign oral tumors are gingival masses that have historically been referred to as “epulides”. The current terminology for the most benign types (previously fibromatous or ossifying epulis) is peripheral odontogenic fibroma, of which a tumor may be the ossifying type or fibromatous type. A third type of “epulis” was previously termed acanthomatous epulis, but the current term is acanthomatous ameloblastoma. This is an example of a type of tumor that is technically benign because it does not metastasize but can be very locally invasive, exhibiting

clinical behavior similar to a malignant neoplasm. Numerous other benign and malignant oral neoplasms have been reported in the literature.

If an oral mass is identified on oral examination, then a conversation with the pet owner must occur. For veterinarians in a primary care role, this will likely be the first time that the owner is made aware of the problem in the mouth. At that time, the practitioner should discuss the plan for diagnosing and/or treating the oral mass. When a diagnosis is unknown, a tissue biopsy submitted for histopathology is the best method for obtaining a definitive diagnosis. Although it may seem simpler and more cost effective, fine needle aspiration with cytology has not been proven to be a reliable diagnostic tool for all types of oral masses. In some cases, fine needle aspiration and cytology may provide results that are equivocal and/or misleading. This could lead to a delay in time to diagnosis, as well as potentially increasing the cost to the pet owner if biopsy must then be performed.

Depending on the size and location of the oral mass, an incisional or excisional biopsy may be performed. If the clinical or radiographic signs suggest that the mass is likely to be benign and it is small and easily resectable, then excision of the mass with appropriate margins may be performed. Potentially, the oral mass can be diagnosed and treated in one procedure. Most benign oral tumors carry an excellent prognosis with complete excision and a clinical cure can be achieved. Keep in mind that some benign tumors that appear to only grow on the gingiva may originate deep to the gingiva in either the alveolar bone or periodontal ligament space. In some cases, it is necessary to excise teeth and alveolar bone in order to completely excise the tumor. En bloc excision of a tumor with 0.5 to 1 cm of normal appearing tissue will result in complete excision of most benign oral tumors. One exception to this may be the acanthomatous ameloblastoma, which may require tumor free margins of at least 1 cm.

If the mass is thought to be malignant or it is large or in an area where resection would be difficult, then the primary care veterinarian should recommend an incisional biopsy. Although anesthesia is usually required for this procedure, it affords the veterinarian an opportunity to better evaluate the extent of the oral mass and take dental radiographs (if available) to assess the bone involvement and potential tumor margins. The benefits of making a diagnosis prior to definitive surgery to remove the mass are many. Once a diagnosis has been made, then the veterinarian can determine how much concern there should be for regional or distant metastasis. If the veterinarian is not able to offer definitive surgery to remove the mass, then referral should be considered. The information provided to the specialist, including diagnosis as well as the oral examination and radiographic findings, will help the specialist in informing the primary care veterinarian whether surgery is the treatment of choice and how likely it is to be successful. The veterinarian may then be able to assist the owner in deciding whether to pursue additional treatment or not. The two primary disadvantages to an incisional biopsy are the need for a second anesthetic procedure to remove the mass and the additional cost to the owner of a second anesthesia. In my opinion, neither of these factors should outweigh the benefits of being able to plan well for surgical resection after a diagnosis has been made.

There are some important considerations when performing an incisional biopsy and it would be better to refer the case than it would be to perform a less than ideal incisional biopsy. When performing an incisional biopsy on an oral mass, the specimen should be obtained from a centrally located area of the mass that is representative of the mass as a whole. A punch biopsy may be appropriate if the sample size is at least 0.5 cm in diameter, but this should be considered a minimum. A larger sample size will increase the likelihood of a diagnosis. In some cases, extraction of severely diseased teeth that are centrally located within a mass may provide a site for tumor tissue to be obtained. Ideally, the biopsy site is sutured closed after the

procedure to minimize post-operative bleeding. There are two primary goals for the incisional biopsy: 1. obtain a representative sample(s) that will give a definitive diagnosis and 2. perform the incisional biopsy in a way that will not adversely affect excision of the mass if it is performed later. An incisional biopsy should not be performed at the margins of a mass in an attempt to obtain some normal and some abnormal tissue. A biopsy performed in this way effectively increases the size of the diseased tissue by potentially contaminating healthy tissue with tumor cells, resulting in even wider surgical margins at the time of resection. Also, removal of most of a mass for a biopsy procedure (so-called "debulking") can then contaminate normal tissue with tumor cells if it is closed over a site where tumor removal was incomplete.

If metastatic disease is a possibility, then it may be helpful to rule it out first with regional lymph node aspirate with cytology and/or chest radiographs. Lymph node aspiration and cytology is a highly sensitive test for the presence of metastatic disease. The presence of regional or distant metastasis could influence the decision-making process for the pet owner.

Dental Radiography Interpretation

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1. **Normal dental anatomy:** To be able to recognize dental pathology, you must be able to recognize normal anatomy. There are several essential points to reviewing dental radiographs. First, orientation of the film or digital image is important to discern the location of the mouth being radiographed. The crowns of maxillary teeth should be oriented downward on the image. Conversely, the crowns of the mandibular teeth should be oriented upward on the image. Images of the patient's right side should be oriented with the more caudal teeth toward the left side of the image and the teeth towards midline toward the right side of the image. The reverse is true for images of the teeth on the left side of the mouth. When looking at a dental radiograph, note the crown, roots, pulp canal, alveolar bone, and periapical area. The crown and roots should be normal size and shape. There are instances when the ectodermal portions of a tooth (the enamel and root sheath template) are disrupted, such as enamel hypoplasia. In some of these cases, the root development is disrupted and the roots are abnormally short. The crown should also be of normal size and shape. Clinical oral examination will usually tell you all you need to know about the crown, but in some cases, the radiograph can be very helpful. The pulp canal size should be relatively uniform in all the teeth viewed within the same patient. Discrepancies may indicate pathology. Mineralizations within the pulp canal are occasionally seen, but do not always represent significant pathology. The pulp canal is wide in immature teeth and continues to narrow with age. This information is particularly helpful when trying to determine the vitality of certain teeth. The alveolar bone is very important in the assessment of the periodontal health of a tooth. As periodontal disease progresses to periodontitis (the active breakdown of the alveolar bone), then radiographically we should be able to see the loss of alveolar bone around roots. Alveolar bone loss of less than 50% may be able to be managed with periodontal therapy. Traditionally, alveolar bone loss greater than 50% would be indication to consider extraction, but in some cases, advanced periodontal bone regeneration can be attempted and some of these teeth can be saved.

2. **Periodontal Disease:** While the periodontal probe is the most effective tool to detect clinical evidence of periodontal tissue loss, without dental radiographs, we are only able to estimate the actual damage. Dental radiographs are essential to see the true loss of alveolar bone and assess whether or not a tooth is salvageable.

3. **Discolored Teeth:** A discolored tooth is an infrequent occurrence, but can be a hidden source of infection within the oral cavity. Most traumatic insults to a tooth result in a fracture of the involved tooth with or without exposure of the pulp canal. If the pulp canal is exposed, this is a portal for entry for bacteria into the pulp tissue, death of the pulp nerve, and a potential source of tooth root infection or abscess. The discolored tooth presents a different dilemma. Teeth may discolor due to administration of tetracycline type antibiotics, internal resorption, external stains, mineral uptake from drinking water, or most commonly from intrinsic staining resulting from trauma to the tooth that does not result in tooth fracture.

A tooth that has experienced blunt trauma without the force to fracture the crown may exhibit signs of pulpitis, an inflammation of the pulp tissue. The concussive force is not severe enough to break the tooth, but results in disruption of some of the tiny blood vessels within the

pulp tissue along with the release of inflammatory mediators. The bleeding within the pulp canal allows blood pigments to seep into the porous dentin underneath the ceramic-like enamel that covers a tooth, giving the appearance of a pink discoloration. If this inflammation of the pulp is controlled early, then the pulp does not undergo death, but if the swelling continues within the rigid walls of the pulp canal, then the pulpitis may result in pulp necrosis. Over time, the blood pigments that have leached into the dentin of the tooth change color, so the tooth's appearance also changes from a pink discoloration to a grey or tan color.

Only one study exists describing this problem in dogs. A study was published in the *Journal of Veterinary Dentistry* that reported the incidence of complete or partial pulp necrosis in discolored teeth to be 92.2% (JVD, Vol. 18, No. 1, pp 14-20.). The study involved gross examination of the pulp tissue of 64 discolored teeth. Of those, only 2 (4.1%) had vital pulp tissue. Radiographic evidence of pulp necrosis (tooth death) was evident in 58.1% of the cases. The study concluded "that a distinct majority of teeth (92.2%) with pink/purple/grey/tan crown discoloration had either partial or total pulp necrosis based on visual examination of the pulp during root canal therapy or exploratory pulpotomy", and that "Radiographic signs of endodontic disease were not present in 42.4% of these teeth." Further conclusions included, "The results reported here support the treatment recommendation that all discolored teeth receive either endodontic (root canal) or exodontic (extraction) therapy."

Since the tooth in essence dies at the time the irreversible pulpitis occurs, there may be radiographic evidence that will help confirm your diagnosis. An immature tooth will have a wide pulp canal as viewed on a radiograph. As the tooth matures, the dentin becomes thicker and the pulp canal diameter diminishes. Therefore, if a tooth receives blunt trauma, discolors, and dies at a young age, the affected tooth stops maturing at that point and the pulp canal stays suspended at that size indefinitely as the other normal, healthy teeth around it continue to mature. Over time, when the dead tooth is compared radiographically to the same tooth on the opposite side of the arch, a discrepancy in size of the pulp canal is noticed. This is a strong indication this tooth has undergone irreversible pulpitis and may likely have pulp necrosis. Remember however, only around 40% of these teeth with necrotic pulps will show radiographic evidence of death, so this is not a totally reliable test, but if it shows, then there is strong indication this tooth is in fact non-vital. Other radiographic signs may include discrepancy in size of the pulp canal between the crown and root or evidence of periapical bone loss suggestive of apical infection/abscess.

The major concern for these teeth is that the necrotic pulp can serve as a nidus for infection and/or inflammation and this tooth could potentially abscess without ever showing any clinical signs. The result for this pet would be a chronic aching tooth and it's immune system would be constantly fighting an infection that could be treated. As the study suggested, at this time, based on the low incidence of vital pulps in discolored teeth, either extraction of the tooth or root canal therapy to save the tooth is indicated to remove this potential source of chronic infection and optimize the health of our patients.

4. **Sub-orbital swellings:** This is a common condition seen in small animal practice. In some cases, the swelling is rostral to the orbit, just below the orbit, or in the retro-orbital space. In any of these instances, I think of three common "rule-outs". The majority of these swellings will be either an abscess, neoplasia, or cyst. Other less commonly seen problems include zygomatic salivary gland adenitis or mucocele, buccal molar lymphadenopathy, or foreign body infection.

- A. Abscesses: These are usually associated with a tooth root abscess and are typically endodontic in origin, but they can be the result of advanced periodontal disease. There is no age, breed, or sex predilection. Periapical abscesses

usually respond favorably to antibiotics while on the medication, but then recur once therapy is discontinued. The recurrence of the swelling may be immediate or take weeks or months to return. On physical examination, if a broken tooth with pulp exposure or discolored tooth is noted in the region of the swelling, then this is the likely culprit. Definitive diagnosis can usually be obtained with dental x-rays. Once the affected tooth/teeth is/are identified, then treatment options can be discussed with the owner. If the abscess is due to endodontic disease, then the owner has the option of either extraction or root canal therapy. Interestingly, most abscessed teeth do not show outward signs, such as drainage or facial swelling. The majority of broken teeth with infected pulp seem to smolder as a chronic periapical infection which may go on for years with no obvious clinical signs. If the tooth abscess is due to periodontal disease, then extraction is the only treatment option. Once the source of the infection is removed, the swelling should resolve quickly.

- B. **Neoplasia:** Some suborbital swellings are due to oral tumor development in the caudal maxilla with tumor invasion dorsally in the maxillary bone. Usually these are seen in older animals and tend not to respond to antibiotic therapy. Again, dental x-rays can be very helpful in determining the cause of the swelling and can help show lysis caused by invasive tumors. The dental x-rays will help determine if surgical margins are possible. CT scans are also very helpful in determining the viability of surgery. The final diagnosis usually will require histopathologic evaluation of the involved tissue, and definitive treatment will depend on tumor type, evidence of metastasis, and the desires and expectations of the owner.

- C. **Cysts:** While relatively uncommon, cysts can be a cause of swelling in the sub-orbital area. The most common cyst that we see in the oral cavity of dogs and cats is the dentigerous cyst. This is a fluid filled sac that develops around an unerupted tooth. These can occur at any age, but are typically younger animals, between 1-3 years of age. Missing teeth in the area of a swelling might be an indication clinically that a cyst could be the etiology. Dentigerous cysts are more common in the brachycephalic breeds such as the Boxer, Boston Terrier, and Bulldog. The mandibular first premolar is the most commonly involved tooth, but this has been seen in the caudal maxilla and can result in a sub-orbital swelling. Again, dental x-rays will be very helpful in diagnosis, and treatment is aimed at removal of the unerupted tooth as well as curettage/removal of the cyst lining.

5. Missing Teeth: See the discussion above regarding cysts. Other causes of missing teeth might be trauma or congenitally absent teeth. In some cases teeth simply don't develop. This is not a major problem for most dogs, but for some breeds of show dogs, such as Dobermans and Rottweiler, it can be a major fault.

6. Resorptive Lesions: Clinically we know what resorptive lesions look like, but what is considered the standard of care for treatment? Dental radiographs again are essential to determine proper treatment. There are basically two types of resorptive lesions. Type I where the lesion is limited to the area near the cemento-enamel junction (near the neck of the tooth, or gingival margin) such that the root is clearly visible with a normal periodontal ligament space on a dental radiograph. In contrast, Type II lesions show the generalized loss of discernible root. This is a replacement type resorption, where the root tissue is resorbing and being replaced by

bone. In the case of Type I lesions, complete extraction of the tooth and root(s) is indicated. With Type II lesions, if there is not significant vertical alveolar bone loss due to periodontal disease, no radiographic evidence of periapical osteolysis or clinical evidence of necrotic pulp, and the patient is not suffering from a form of stomatitis, then crown amputation with intentional root retention is a viable treatment option.