Dealing With the Damaged Tooth: From Chips to Avulsions

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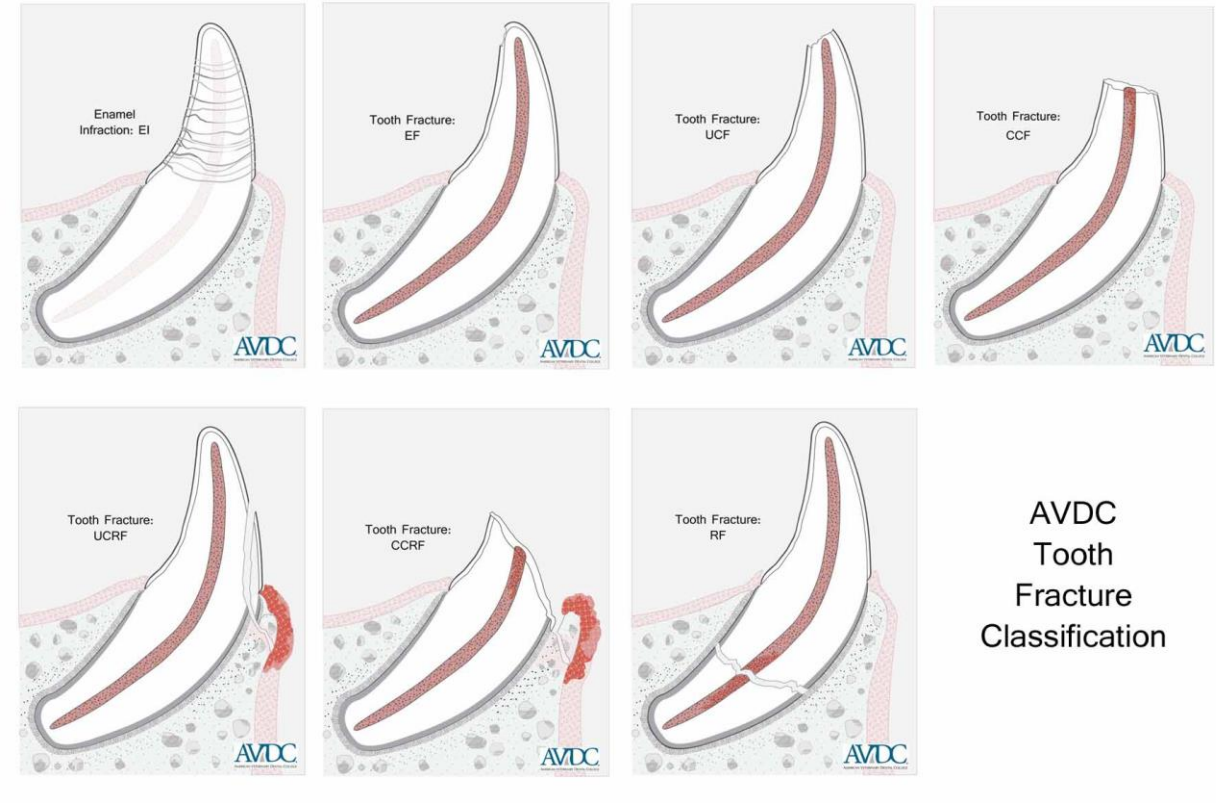
Teeth take a brunt of force in normal activities such as playing, working, and even in normal mastication. Due to their relative inelasticity, in many cases, the tooth ends up fractured or otherwise traumatized. The extent of the fracture can vary in every instance ,and from a clinical standpoint, may be as minor as not needing any treatment to needing endodontic therapy or extraction. The American Veterinary Dental College Nomenclature Committee has created examples of each type of fracture and listed examples on their website for all to use. These examples can be found at: www.avdc.org

Tooth Fracture Classifications:



Teeth are usually strong, but in cases of trauma or developmental defects, lesions can occur. Important clinical considerations include the source of trauma/wear, amount of remaining crown/tooth structure, overall health of the tooth, importance of tooth for function or esthetics, and likelihood of trauma to continue. We will investigate a clinically based review of dental lesions including:

- Worn Teeth
- Uncomplicated Crown Fractures
- Uncomplicated Crown/Root Fractures
- Complicated Crown Fractures
- Root Fractures
- Carious Lesions
- Enamel Hypoplasia
- Discolored Crowns
- Sub-luxated, Luxated or Avulsed Teeth

1. Worn Teeth: Due to aggressive chewing or abrasive materials, wear of the teeth may occur. Technically speaking, attrition is the normal wearing of the cusps or occlusal surfaces of teeth during mastication. Abrasion is the abnormal wear of teeth when chewing on objects not intended for ingestion. Either condition may result in loss of tooth structure and are treated similarly. Clinically what is important is whether the pulp canal has been exposed or is near enough to exposure to allow bacterial contamination into the endodontic canal. Dental radiographs with comparison of the same contralateral tooth may be helpful along with transillumination and careful exploration of the fracture surface for pulp exposure can assist in trying to determine if the pulp is indeed still vital. Worn teeth without pulp exposure where there is no radiographic evidence there is pulp necrosis and that transilluminate normally may be vital, but these teeth need to be re-evaluated radiographically periodically.
The tooth itself is comprised of three major components: pulp, dentin, and enamel. The pulp is the innermost layer of the tooth and is made up of vessels and nerves that provide nutrition and sensation to the tooth. The major cell type found is the fibroblast, but the cell of notoriety is the odontoblast. The odontoblast's function is to make dentin and continues to do so throughout the life of the tooth. As such, the pulp cavity starts out very wide in an immature tooth and as the tooth, and patient, mature, the pulp canal becomes more narrow and the dentin around the pulp thickens. The part of the pulp cavity within the crown of the tooth is called the pulp chamber and the part of the pulp cavity within the root is called the root canal. It is important to note that the nerve fibers within the pulp only detect one sensation...pain. There are two types of pain receptors in the pulp, one for sharp acute pain and one for dull throbbing pain. Clinically this becomes very important in a tooth that has had a pulp exposure! The dentin is the middle layer of the tooth and may be thin or thick, depending on the age of the tooth/patient. Dentin is mostly inorganic in matrix, and has small tubules normally that contain fluid and at the interface with the pulp allow odontoblastic processes to reach into these tubules. Anything that causes an abnormal movement of fluid contained within the tubules either in or out will result in sensitivity in a vital tooth. Near pulp exposures can be sensitive and theoretically could allow for bacterial penetration through the dentin to the pulp. Clinically this is important especially in younger patients where the pulp is closer to the outer edges of the tooth. These tubules can be sealed with a dentin bonding agent to help prevent/reduce sensitivity. The dentin extends to the root surface and is covered by a cellular layer called cementum. The outermost extent of dentin within the crown of the tooth meets the enamel which is the outermost covering of the tooth normally exposed through the gingiva. Enamel is 97% inorganic

and is the hardest substance in the body. As such, it is also fairly brittle, like porcelain and does not have the capacity to regenerate itself. In contrast, if the enamel/dentin or root surface are damaged, resulting in sensitivity or irritation to the underlying pulp, the odontoblasts have the capacity to lay down more dentin in response to the irritation if such irritation does not result in the overall death of the pulp. This dentin laid down in response to irritation is also known as reparative dentin. This type of dentin can be seen in teeth that have had slow progressive wear. The result is a dark stained center with no observable pulp exposure. Clinically, if these teeth have no pulp exposure, and are radiographically normal, then dentin bonding may help reduce the irritation to the pulp, and if the source of wear can be removed, then these teeth may continue to remain vital. Follow-up radiographs and visual evaluation are recommended in 6-12 months following treatment.

The pulp has a defense system to help prevent or alleviate irritation. As wear encroaches on the pulp, the odontoblasts are stimulated to produce tertiary dentin, an irregularly placed dentin to help increase dentin wall thickness at the site of irritation. In cases where the wear is at the cusp tip, the pulp actually recedes away from the wear leaving tertiary dentin. This type of dentin accumulates stain and may appear brown. Worn teeth in some cases clinically have a smooth surface with a dark stain. Careful exploration should reveal if the pulp canal has been entered. If so, then either extraction or root canal therapy is indicated. If not, then dental radiography/evaluation and either root canal therapy/extraction if the tooth appears non-vital or dentin bonding or crown placement for protection if is appears vital.

2. Uncomplicated crown fractures: For crown fractures that do not involve the pulp or root structure, there may be several options based on the extent of the tooth damage. For enamel infractions, generally these are of no clinical significance and no treatment is needed, however, dental radiographs and transillumination with comparison of the same tooth in the opposite side of the arcade can be helpful to determine if the tooth is vital. For enamel fractures, without invasion into the dentin, smoothing with an arkansas white stone, etching, placement of a bonding agent and composite veneer restoration will help return the surface smoothness of the enamel and help prevent plaque and calculus deposition. For uncomplicated crown fractures, these are likely to be sensitive due to the exposure of the dentin. Treatment involves, cleaning and smoothing any rough enamel edges, evaluating radiographically and clinically to be certain the pulp is not exposed, non-fluoride pumice polishing, acid etching, and at least application of a dentin bonding agent. This should seal any exposed dentinal tubules and prevent/reduce sensitivity. To further improve on the clinical scenario, a composite veneer restoration again will help return the surface smoothness of the tooth to help reduce plaque and calculus deposition. If the fracture involves a cusp, the composite veneer restoration need not go over the cusp as it can be easily refractured. If this type lesion extends very near to the pulp, as evidenced by a pink hue or “blush” seen clinically within the dentin, a protective layer of cement, such as calcium hydroxide cement (DyCal-Dentsply, Inc.) just over the area of near exposure to provide protection to the underlying pulp and then the restoration is placed over this material. Deeper lesions into the pulp require endodontic therapy or extraction.

The materials used for restorations include: non-fluoride pumice, 37% phosphoric acid etch, a bonding agent, and possibly glass ionomer, composite, amalgam, metal crowns, or other restorative material. The non-fluoride pumice is used to help clean the surface of the tooth without adding waxes or fluoride which may inhibit the overall bonding of materials to the tooth. The 37% phosphoric acid is used in most cases to etch the enamel prisms of the enamel and open the dentinal tubules to allow micromechanical attachment of the bonding agent to a hybrid layer of collagen and water within the dentinal tubules. This bonding of the hybrid collagen layer greatly enhances the bonding. Over the years, bonding agents have improved on their bond strengths, ease of use, or time required to place and set and each new upgrade is called a new generation. Within the last ten years, bonding agents have improved from the 4th generation bonding agents which required a dentin conditioner layer and two separate liquids mixed together and then applied to an acid etched surface of the tooth, to 5th generation bonding agents which did not require the dentin conditioner and many were premixed in one bottle which was applied to an acid etched tooth surface, and now 6th generation bonding agents which have the acid etch within one package that is applied with the bonding agent and allowed to dry. Some bonding agents are light cured, or harden in response to a specific wavelength of light and some are chemically cured by mixing two materials together. Dual cure bonding agents have the ability of both, the chemical cure or light cure which allows for faster setting when a light is used plus a complete cure if there are areas not reached by the light. The bonding agent is sometimes referred to as an "unfilled resin". In contrast, "filled resins" also known as composites are basically the bonding agent that has been filled with particles of glass, plastic, or fibers that impart some special characteristic such as color, added resistance to wear, or resistance to fracture. Composites also are categorized based on their viscosity with some being relatively liquid called flowable composites and others that are fairly firm called compactible composites. Some have large filler particles called "macro filled" composites which make them more wear resistant and others have small particles called "microfilled" composites which are easier to polish. A combination of small filler particles with large particles made to give wear resistance while giving a smooth polishable surface are called "hybrid" composites. All of these can be colored with different shades in order to match as close as possible the tooth being restored. Glass ionomers are cements made of glass particles that actually create a weak ionic bond to the dentin surface. These are good for sealing the tooth for instance between the vital pulp and final composite restorations in vital pulpotomy procedures and underneath final fillings of complete pulpectomy and standard root canal procedures. These were once used extensively for fillings in resorptive lesions in cats, because they also have the added advantage of releasing small amounts of fluoride, but as was later discovered, many of these fillings failed due to continued resorption of the tooth by odontoclasts. Amalgam was once the mainstay of all cavity fillings. A mixture of silver mercury, and tin, this material had the advantages of being moldable into cavity defects and was very hard once set in place, especially good for the occlusal surface of teeth. The disadvantages include it's relative technique sensitive nature, it's inability to directly bond to the tooth (although there are now amalgam bonding agents available), the fact that it releases tiny amounts of mercury, and if placed in the presence of moisture

expansion during the setting which could result in further damage such as splitting of the crown.

There are many clinical instances where dentin bonding agents and composite restoration may be indicated. Worn teeth with near pulp exposures, enamel chip fractures, enamel developmental defects, carious lesions, early resorptive lesions, cosmetic restorations, and endodontic access locations all are indications where restorations may be needed. As such, a basic understanding of the importance exposed dentin and the benefits of sealing a damaged tooth along with the knowledge of what restorations can to to help these damaged teeth, will help the practitioner, patient, and client make better decisions regarding the overall dental health.

STEPS TO RESTORATION OF A TOOTH:

1. Evaluate the fractured surface and radiograph
2. Smooth any rough edges of enamel and any dentinal irregularities with an Arkansas White Stone in a highspeed handpiece or other polishing discs
3. Rinse well with water and air dry
4. Apply 37% phosphoric acid etch to enamel edges for 30 seconds and dentin for 10 seconds
5. Rinse well and air dry lightly
6. Mix/apply the bonding agent of choice according to manufacturers recommendations to the prepared tooth surface
7. Lightly air dry
8. Light cure if necessary for the recommended time by the manufacturer of the bonding agent (typically 10-30 seconds)
9. Repeat the bonding for 2 more layers (do not etch, only reapply the bonding agent, dry and cure)
10. If desired, apply composite in 2mm increments and light cure for recommended times
11. Polish with coarse, medium, fine, and superfine grit polishing discs to get a smooth restoration surface and recontour to replace the missing desired tooth anatomy
12. Place a final layer of bonding agent over the composite restoration, lightly air dry, and light cure for the recommended amount of time to seal any micro cracks that could have developed at the time of composite curing.

*These steps are intended as recommendations and are not hard and fast roles for every scenario and every type of dental restorative material. Please refer to your material's recommended instructions for more specific information.

3. Uncomplicated (or Complicated) crown-root fractures: Some fractures of the crown, while they don't involve the pulp, may extend subgingivally along the root. It is hard to find references with hard and fast rules to relegate treatment decisions, basically, the practitioner needs to use his/her clinical judgement to decide if the overall periodontal health of the tooth has been jeopardized. If the fracture extends below the gingival margin, the extent must be explored. In some cases, gingival flap

surgery will be indicated to fully evaluate the extent of the fracture. If the fracture extends further apical than the mucogingival line beneath the gingiva, then either the attached gingiva may need to be repositioned more apically, recontouring the alveolar bone to allow for normal biologic attachment of the gingiva in it's new location, or if in an area that this cannot be performed and there will remain periodontal pocketing alongside the treated tooth, then the owner should be made aware that this tooth may develop periodontal disease and could be a source of chronic infection in the future and may be indicated for extraction due to this problem later. Some clients are willing to take that risk in an effort to save the tooth, while others may opt for extraction.

4. Complicated Crown Fracture: If the pulp canal is involved, or if there are signs of pulp necrosis, then endodontic or exodontic therapy is indicated. If the tooth has been fractured less than 48 hours, a partial coronal pulpectomy and vital pulp therapy (vital pulpotomy) is an option. Based on human studies, the success rate of this procedure is approximately 85%, which means the tooth stays vital. Most veterinary dentists are performing this treatment less and less, especially if the tooth is a mature tooth since total pulpectomy and standard root canal therapy seems to have a higher success rate. If the tooth has an open apex or a very wide pulp canal, then vital pulp therapy may allow the tooth to mature more to a level where standard root canal therapy is easier and would carry a higher success rate. If the tooth is an immature tooth with an open apex and is older than 48 hours, then consideration should be given for apexification (removing the pulp contents and replacing with either calcium hydroxide paste or mineral trioxide aggregate-MTA) to give the body a chance to fill in around the apex of the tooth wit firm osteoid creating a root terminus for eventual standard root canal therapy with MTA at the apex. Most "complicated" crown fractures involve mature teeth and most are greater than 48 hours old, leaving the two basic options of either standard root canal therapy if the tooth is periodontally sound and if the roots are not undergoing inflammatory root resorption or extraction.

5. Root fractures: It is possible for the root to fracture without traumatizing the crown. As a very simplistic rule, the closer the root fracture is to the apex and the more stable the coronal segment is, then the better the prognosis. If the tooth is vital and the coronal segment is stable, then no treatment may be needed. If the crown is not stable and the tooth is or was recently vital, regardless of where the root fracture is, then stabilizing the tooth with an interdental splint is indicated. In some cases, osteoid can fill in the fracture site, stabilizing the tooth and maintaining the tooth as a vital tooth. If the tooth is or becomes non-vital there are a number of possible procedures to maintain the tooth, but the prognosis decreases. Options for non-vital teeth with root fractures include:

Standard root canal procedure on both the coronal and apical segment
Root canal therapy for the coronal segment and no treatment for the apical segment
Coronal segment apexification followed by standard root canal therapy of the coronal segment with no treatment of the apical segment
Intraradicular splint with root canal therapy and a post placed into both the coronal and apical segment

endodontic implant in which the apical part of the implant replaces the surgically removed apical segment of root
removal of the coronal segment and root extrusion followed by root canal therapy of the remaining root segment and post/core build-up for restoration
From: Principles and Practice of Endodontics by Walton & Torebinejad, Saunders, 2002

6. Carious lesions: True carious lesions (sometimes called "cavities") are not as common in dogs and cats as they are in humans. It is theorized this is due to difference in shape of the crown, material ingested, natural oral flora bacteria and pH of the saliva among other things. True carious lesions are caused by certain bacteria (Steptococcus mutans is the primary culprit in humans) that digest carbohydrates (CHOs) and produce an acid that demineralizes the enamel such that the destruction can continue into the dentin and possibly the pulp. For this reason, small enamel carious lesions may be larger than expected once the diseased enamel is removed and the full extent of dentin destruction is realized. The occlusal surfaces of the molar teeth are the most common location, but these can occur in the developmental grooves of premolar teeth, interproximal areas between teeth, and along the root surfaces. Treatment involves removal of the diseased or demineralized tooth structure and replacing it with a restorative material. See the information listed above for placement of a composite restoration.

7. Enamel hypoplasia: Disruption of ameloblasts during the development of the tooth can result in a loss of enamel or a defect in the mineralization of the enamel (hypomineralization). Enamel hypoplasia is a focal or generalized complete loss of enamel structure revealing the underlying dentin. Enamel hypomineralization is a focal or generalized lack of hard enamel structure clinically seen as a soft, rough irregular surface of enamel that can be scaled away easily with an ultrasonic scaler. The end result of either process is a loss of the protective non-porous layer of smooth enamel over the tooth's crown. The exposure of dentin can allow for dentin sensitivity. See the discussion in item #1 above for "Worn Teeth". Another important clinical consideration is that when the enamel is formed by the ameloblasts, the roots are also being formed by another epithelial tissue, Hertwig's epithelial root sheath which acts as a template for root formation. Some epitheliotrophic viruses not only disrupt the enamel formation, but also the root formation. The clinical result is shortened, blunted roots. Full mouth dental radiographs are indicated in these cases to help detect root hypoplasia. Even if root hypoplasia is found, there is no known treatment to stimulate the root to form, as this is only informational such that the owner should be warned a small amount of periodontal disease or less than normal crown stresses may dislodge normal appearing teeth pre-maturely. Treatment of these teeth is aimed at preventing dentin sensitivity and creating a plaque retardant surface to re-create the lost enamel. Treatment involves anesthesia, full mouth dental x-rays, thorough cleaning of the teeth, non-fluoride pumice polishing, acid etching, dentin bonding and composite restoration of all teeth or select teeth depending on the wishes of the client.

8. Discolored Teeth: Until a relatively recent study published by Dr. Fraser Hale, Dipl. AVDC, in the Journal of Veterinary Dentistry, discolored teeth had been a diagnostic dilemma in veterinary dentistry. Since pulp testers made for humans usually required the recognition and communication of some stimuli to a questionable tooth, they were not very reliable for our patients. Previously, we used dental radiographs and transillumination to help us decide if teeth were vital. By looking at radiographs, we would compare pulp canal width with the corresponding tooth on the opposite side of the arch. If the pulp canal was wider on the affected tooth, then we could conclude this tooth was no longer maturing and was considered non-vital. In some instances, periapical changes might indicate infection/abscess as well. Transillumination is the process of passing a bright light source behind a tooth, like candelling an egg, to check for vitality. A vital tooth will be translucent and a non-vital tooth will have a "shadow" within the tooth. While this test is subjective, it can be used as an aid in questionable teeth. My approach to these cases changed after publication of Dr. Hale's findings. He noted that more than 90% of teeth with discolored crowns actually had non-vital pulps. Non-vital pulps eventually necrose, setting the stage for infection and abscessation. My current recommendation for significantly discolored teeth is either endodontic or exodontic therapy. For those cases where only a small part of the crown is discolored, I still recommend regular periodic radiographs and evaluation to hopefully diagnose a non-vital tooth before it causes the patient any problems.

9. Sub-luxated, Luxated, or Avulsed Teeth: These are teeth that have been dislodged from their alveolar socket to varying degrees. A sub-luxated tooth is one that has had trauma to create tooth mobility but has not been displaced out of the alveolar socket. This tooth should be stabilized if necessary with an interdental splint and monitored periodically (every 6 months) for vitality or any signs the tooth is not vital, then further treatment is indicated. A luxated tooth is one that has been within but not completely out of the alveolar socket. These teeth should either be extracted or treated by replantation and endodontic therapy. Replantation involves sterile saline gentle flushing of any clot or debris out of the alveolus, and replacement of the tooth into the alveolus. Any torn soft tissue should be securely sutured and the tooth stabilized with a semi-rigid interdental splint. Since the apical neurovascular bundle was likely disrupted at the time of the trauma this tooth should have standard or retrograde endodontic therapy. An avulsed tooth is one that has been completely displaced out of it's alveolar socket. The neurovascular bundle is definitely damaged and this tooth, if it is to be saved, should be replanted as soon as reasonably and safely possible for the patient. In any case, if the tooth is completely avulsed out of the mouth, it should be immediately placed in either Hank's balanced salt solution (HBSS) or in whole milk in a plastic bag until replantation. HBSS can be found at many pharmacies. The tooth should be gently rinsed with sterile saline and the protocol is followed as above for luxated teeth. An alternative to this is to perform standard root canal therapy on the avulsed tooth prior to replantation, but this should be done with gentle care, holding the root with saline soaked gauze. The goal is to not disrupt any viable periodontal ligament/cementum left on the root surface. Eventual external replacement root resorption is a possible consequence of tooth replantation. Some

studies have recommended the use of calcium hydroxide as either an intermediate obturation or use of a calcium hydroxide endodontic sealer cement in the obturation process (CRCS-Hygenic/Coltene Whaledent)

PAIN MANAGEMENT IN THE DENTAL PATIENT

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Objectives:

To recognize the importance of dental pain management and convey important points of pain management and anesthetic safety to clients. Help alleviate any fears and remove barriers to proper dental treatment. Become familiar with common nerve blocks, the materials needed to perform this procedure and implement them in your practice.

Pathophysiology:

The key sensory tissue to the tooth is the pulp and gingival soft tissue with surrounding alveolar bone. Noxious stimuli to the pulp only results in one sensation...pain. The pulp is innervated with alpha (acute pain) and C-delta (chronic pain) fibers that respond to any stimuli with pain. Try placing an ice cube on your tooth for a few minutes, you can't tell it's cold, but there will be a pain response. For this reason, many people avoid dental procedures and may also do the same for their pets. If we block that stimuli before it starts, then theoretically, pain management should be much easier.

Common Analgesics Used Perioperatively:

Opoids: Morphine, hydromorphone, buprenorphine, fentanyl and others have been advocated for use as a premedication. These medications can be useful for pre, intra, and post-operative analgesia. They act peripherally as well as centrally on the central nervous system to help agonize (stimulate) or antagonize (block) certain receptors to produce analgesic effects. Adverse side effects of respiratory depression, hypotension, and GI upset may be avoided when used in conjuction with a sedative such as diazepam/midazolam, acepromazine or alpha-2 agonist. These are effective for use of mild to severe anticipated pain.

Alpha-2 Agonists: Xylazine and medetomidine are occasionally used in conjuction with opoids or other sedatives to help reduce the amount of each needed to product sedative effects while adding to the analgesic effect. These, like opoids, work both on receptors in the central as well as peripheral nervous system.

NSAIDs: These medications have an anti-inflammatory, analgesic and antipyretic effect and are useful pre-operative as well as intra-operative and post-operative as long as there are no contraindication and perfusion remains normal throughout the procedure. These medications are useful as an injection and can be given orally and, in addition, are not controlled substances.

NMDA Antagonists: Ketamine and amantadine are effective medications to prevent the wind-up effect of pain prior to and during the incitement of pain. Ketamine is easy to add to IV fluids as a CRI and can be used in addition to opoids for effective CRI infusion.

Tramadol: Tramadol is a mu-agonist like some opoids and inhibits the reuptake of serotonin and norepinephrine. It is most useful as an adjunt to other analgesics for post-operative pain rather than used as a sole analgesic agent. Toxicity has been reported in a cat with serotonin syndrome.

Maropitant: At least one study found that the neurokinin-1 antagonist, maropitant, improved visceral analgesia in dogs. This medication may also be used pre-operatively to help reduce vomiting in dogs due to other medications.

Local and Regional Nerve Blocks:
What you need:
1cc syringe with 25 or 27G x 0.5" needle for cats/small dogs
3cc syringe with 25G x 1.5" needle for larger dogs

Max dose of marcaine: 2-4mg/Kg Dog, 0.5-1.0mg/Kg Cat
Max dose of lidocaine: 2-6mg/Kg Dog, 2-6mg/Kg Cat
0.5% marcaine = 5mg/mL
2% lidocaine = 20mg/mL

Infraorbital Nerve Block:

The infraorbital nerve block is performed by injecting 0.1-1.0mL of the local anesthetic of the clinician's preference at the nerve bundle as it exits the infraorbital canal just dorsal to the distal root of the 3rd maxillary premolar by digitally palpating the infraorbital canal and injecting with a 1cc syringe and 25-27 gauge needle. In dogs, the canal is easy to palpate, but if there is difficulty finding it, the neurovascular bundle can usually be palpated by rolling your finger across the buccal mucosa dorsal to the 2nd/3rd maxillary premolars. The neurovascular bundle will palpate similar to a tendon beneath the mucosa. By following this caudally to where the bundle goes into the canal, you can find the infraorbital canal. The author's preference is to inject ventral to the neuromuscular bundle with the bevel of the needle facing the bone until the needle tip reaches the bone, then advancing the tip of the needle to the opening of the foramen. The plunger is always drawn back to ensure the needle tip is not in the infraorbital artery prior to injection. This nerve block should provide regional anesthesia of the buccal mucosa and buccal alveolar bone from the 2nd premolar rostrally to the midline. This should be sufficient for gingival flap surgery in this area, but the deeper infraorbital nerve block is recommended for extraction of these teeth so the superior alveolar nerves are also included in the desensitization.

Maxillary/Deep Infraorbital Nerve Block:

To desensitize the maxillary premolar, canine and incisor teeth on the ipsilateral side, the deep infraorbital nerve block is recommended. By advancing the needle into the infraorbital canal to the level of the medial canthus of the eye, then injecting the local anesthetic, the superior alveolar branches of the infraorbital nerve are blocked which supply the 4th premolar and and the teeth rostral to this level. These nerves enter the incisivomaxillary canal at the caudal extent of the infraorbital foramen just after the infraorbital nerve enters the infraorbital canal. To desensitize further caudally, the needle can be advanced slightly further in the infraorbital canal, or the needle can be inserted into the palate mucosa just caudal to the last molar and advanced 0.5-1.0cm to the level of the maxillary branch of the trigeminal nerve before it enters the infraorbital canal.

Middle Mental Nerve Block:

The middle mental nerve arises from the middle mental foramina just caudal to the mandibular frenulum, ventral to the mesial root of the second premolar or just caudal to the level

of the apex of the mandibular canine tooth. The foramen can usually be palpated by using firm pressure with a finger nail in this area. The foramen will feel like a depression in the bone. This foramen is not readily palpable in the cat. This nerve block should provide analgesia to the mandibular canine tooth and the ipsilateral incisors.

Inferior Alveolar (Mandibular) Nerve Block:

The inferior alveolar nerve block is performed by injecting a small amount of local anesthetic at the midpoint of an imaginary line drawn from the angle of the mandible and the distal aspect of the mandibular first molar tooth. Sometimes, the foramina can be palpated intraorally to give the practitioner a better idea of where this nerve should be blocked. If the foramen can be palpated from within the mouth, the needle can be inserted and advanced to this level, otherwise, the extraoral approach can be utilized. With the extraoral approach to the mandibular alveolar nerve, the index finger is placed on the distal aspect of the last molar, and the thumb is placed on the angle of the mandible and again, an imaginary line formed between these two points. Inserting the needle through the skin on ventral surface of the mandible the tip is advanced until it hits the ventral cortical bone. The tip of the needle is then “walked” off the bone medially until it advances on the medial aspect of the mandible to the point midway of the imaginary line drawn between the thumb and index finger. Particular attention is paid to keep the tip of the needle close to the mandible, and the local anesthesia is delivered at the level of the mandibular alveolar foramen as the mandibular nerve enters this foramen. Caution should be used when performing this block in cats and dogs that are not undergoing mandibulectomy or complete mandibular quadrant extractions due to the proximity of the lingual nerve to the injection site, which could result in loss of sensation to the rostral two-thirds of the tongue and subsequent possible self mutilation.

DENTAL EXTRACTIONS: AVOIDING HEADACHES FOR YOU AND YOUR PATIENTS!

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INTRODUCTION:

In veterinary dentistry, our goal is to save teeth and maintain a healthy oral cavity if at all possible. There are indications, however, that call for extraction of teeth. Extraction of teeth can be relatively easy if periodontal disease is present and has destroyed the attachment of the tooth to the alveolar bone and gingiva, or in other cases, extractions can be difficult, time consuming, frustrating, and painful for our patients. Luckily, there are measures that can be taken to help avoid these problems. This presentation will focus on extraction instrumentation, pain management, basic steps for extractions, and tips for extraction of specific types of teeth.

EQUIPMENT/ INSTRUMENTATION:

Like any other procedure, having good quality equipment can make the job much easier. On the other hand, lack of the correct equipment, or using equipment in disrepair can make for frustrating and time consuming work. A small investment in good equipment pays big dividends in the time saved and the quality of service performed. Many of the instruments and equipment used for veterinary dentistry last for 10 to 20 years if properly maintained.

Dental radiographs are not a necessity for extractions, but they can be helpful in many areas. They can help visualize potential problems such as fractured roots, a weakened or thin bone such as the mandible, or curved roots prior to extraction, thus avoiding potential complications. Dental radiographs also record pathology and are excellent tools for client education. They add value to the procedure and allow clients to understand why the tooth was better off removed and, in many instances, help them understand the fees associated with difficult extractions such as the large roots of canine teeth.

Other than dental x-ray equipment, here is a list of some common extraction equipment:

- Aspirating syringe-- used for injecting local anesthetic
- Local anesthetic—either Lidocaine (1 hr. duration) or Marcaine (8-12 hr. duration)
- Scalpel handle
- Scalpel blade-- #10, 11, or 15
- Periosteal elevator—examples include Molt #2, Molt #4, and Schein ST-7
- Scissors—one for cutting tissue (sharp) and one for cutting suture
- Thumb forceps
- Air driven high speed handpiece
- Burs for handpiece-- #701 and 701L work well for sectioning teeth, round burs for removing bone
- Dental elevators or dental luxators
- Small breed extraction forceps
- Suture—small size, absorbable
- Needle holders—small sizes seem to work better

PAIN MANAGEMENT:

In recent years, pain management has come to the forefront of veterinary medicine. This has also been true with veterinary dentistry. In most cases, the dental patient will be under general anesthesia and therefore, may not feel the affects of a procedure until after waking from anesthesia. With newer anesthetics such as Isoflurane and Sevoflurane, patients recover very quickly with little to no post-operative analgesia. Local anesthetics can be utilized intra-operatively to block noxious pain stimuli before it is transmitted to the neural centers. Local blocks such as intraligamental injections into the periodontal ligament or regional nerve blocks can be used. Local anesthetic with epinephrine can have the added benefit of vasoconstricting vessels in the extraction area, reducing intra-operative bleeding. Use caution or avoid products containing epinephrine in patients with hyperthyroidism, cardiac disease, or under halothane anesthesia. Furthermore, local

anesthetic allows the patient to be maintained at a lighter plane of general anesthetic, reducing the risk of anesthetic complications.

Non-steroidal anti-inflammatory medications (NSAIDS) and opioid based analgesics can be used pre-operatively and postoperatively in association with local anesthetics to enhance pain management. Morphine, buprenorphine, fentanyl, and butorphanol are commonly used as premedication for their analgesic as well as sedative effects. The sedative effects of these medications help with a smooth induction of anesthesia and recovery. NSAIDS such as carprofen are not controlled drugs and can be dispensed for continuing management of mild to moderate pain. If more significant discomfort is expected, fentanyl patches or controlled medication such as hydrocodone can be used, but abuse potential should be given consideration. Dosages for these medications should be followed according to manufacturer's recommendations or be reviewed in a current formulary prior to administration.

10 BASIC STEPS FOR EXTRACTING TEETH:

1. Radiograph site: As mentioned earlier, dental radiographs provide vital information that can help avoid potential complications. They also serve to form a part of the medical record and assist in the decision making process for recommending extraction. Dental radiographs furthermore enhance the value of such a procedure by showing clients the actual pathology taking place with a particular tooth and the special considerations when extracting large or multirooted teeth.
2. Sever the epithelial attachment: A tooth is held into the bony socket by the peridontium: alveolar bone, cementum, periodontal ligament, and gingival. The first layer of peridontium to break down is the epithelial attachment of the gingival. This is easily done by incising through the attachment with a scalpel blade. The #11 scalpel blade works well.
3. Elevate the gingival: For surgical extractions, reflecting the gingival away from the alveolar bone and roots of the teeth helps visualize the extraction site and allows for alveoloplasty, removal of some of the alveolar bone to make extraction of large roots or multiple roots easier. Care should be taken when making incisions through the gingival to avoid major vessels, nerves, and salivary ducts. Those of importance include the infra-orbital vessels and nerve as they exit the infra-orbital canal, the middle mental nerve as it exits the middle mental foramen, and the parotid and zygomatic salivary ducts.
4. Section the tooth: Section multi-rooted teeth into single root segments, then elevate them one root at a time. These teeth have diverging roots that are meant to "lock" the tooth into the bone. By sectioning the teeth, the root segments should be removed easier. To section a tooth, use a crosscut fissure type bur such as a 700, 701, or 701L in the high speed handpiece.
5. Remove alveolar bone: If necessary, some of the buccal alveolar bone can be removed to enhance visualization and access to the roots of some teeth. This is done with a round ball bur in a high speed handpiece with water cooling to prevent thermal necrosis of the remaining bone. See figures 1 and 2 for alveoloplasty sites for large and multirooted teeth.

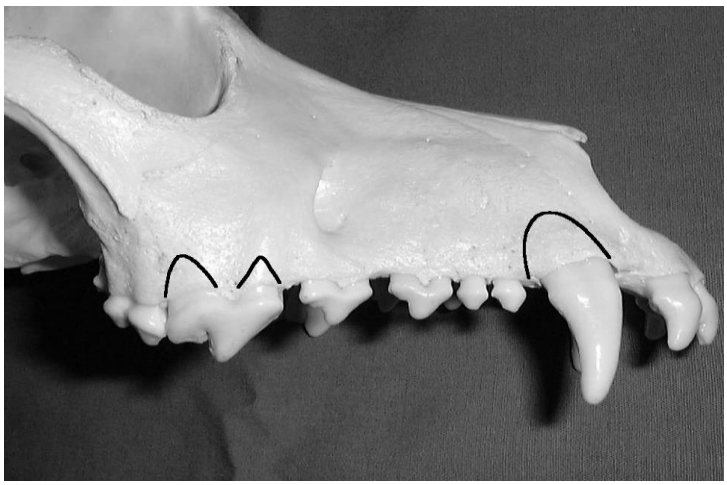

Figure 1: Alveoloplasty sites for the maxillary canine and 4th premolar.

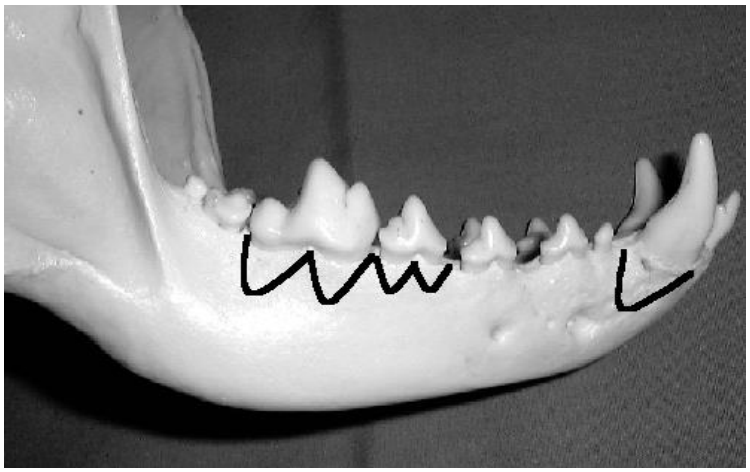

Figure 2: Alveoloplasty sites for large teeth of the mandible. Note the middle mental foramen below the second premolar.

6. Elevate or luxate tooth: Using elevators or luxators, break down the periodontal ligament attachment to the tooth root. One tip when using elevators is to use them with steady force for a period of 30-60 seconds in different directions to fatigue the periodontal ligament.
7. Extract the tooth/ root segments: Once the tooth or root segments start to loosen, grasp the tooth as close to the root as possible with extraction forceps and gently turn while extracting the root, like opening a door. Only use this technique when the root segments are loose, otherwise, the tooth may break at the crown-root junction.
8. Debride/ alveoloplasty: Once all teeth/ roots are removed, the empty alveolar socket should be flushed, and all infected tissue removed by curettage. Bony prominences or spicules can be smoothed with a bur in the high speed handpiece or with rongeurs. This prepares the extraction site for closure of the gingival.
9. Alveolar Ridge Maintenance (ARM): ARM is the preservation of the integrity of bone in an extraction site by placing an osseopromotive substance in the extraction site prior to suturing the gingival closed. This is not necessary in all extraction sites, but can be helpful in areas that might be weakened by bone atrophy after extraction of large roots, such as the mandibular canine tooth and the mandibular first molar. These areas are susceptible to pathologic fracture if periodontal disease has already weakened them.
10. Suture/close the gingival: Most extraction sites can be closed relatively easily following extraction. One key principle to successful healing is to ensure there is no tension on the gingival when closed. One way to help reduce the tension of a gingival flap closure is to cut the periosteal attachment on the underside of the flap to “release” the flap and allow it to be more elastic to cover larger defects without tension. One area difficult to close is the maxillary first molar due to its caudal location ond lack of soft tissue for repositioning without potential to adjacent structures such as the parotid salivary duct. Use of hemostatic agents such as aluminum chloride solution with steady pressure will allow clot formation and granulation of the site.

EXTRACTION OF SPECIFIC TYPES OF TEETH:

13. Incisor: Usually can be elevated after severing the epithelial attachment with a scalpel blade. Gingival flaps are typically not necessary, but can be used if needed to visualize the root or fractured root. Side to side elevation is limited, therefore elevate on the labial and lingual sides.
14. Canine: The large root of the canine makes it difficult if not impossible to extract without a surgical approach unless periodontal disease has helped the process. To extract these teeth, incise the epithelial attachment with a scalpel blade and reflect a gingival flap. You may or may not need to extend the incision with releasing incisions directed apically at the front and back of the tooth (mesial and distal). Reflect the gingival with a periosteal elevator. Use a round bur on the high speed handpiece to remove the buccal alveolar bone over the root. If this is a mandibular canine, be aware

of where the middle mental foramen is and avoid damaging the vessels and nerves that exit. Elevate on the front and back of the tooth (mesial and distal) using steady pressure until the periodontal ligament starts to fatigue and the tooth loosens. At this point, elevate on the palatal and/ or lingual until the tooth is sufficiently loose to be removed with the extraction forceps. Once removed, the alveolus can be debrided, bony prominences removed with a bur, and the underside of the gingival flap incised through the periosteal attachment. The edges of the flap are opposed and closed with absorbable suture.

15. Premolar: Similar to the canine tooth with respect to the gingival flap, but some of these are multi-rooted and need to be sectioned into single rooted segments.
16. Molar: Same as the premolars, section into individual root segments and elevate. Consider ARM at the mandibular first molar site to maintain bone integrity.

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4. Lobprise, H.B. and Wiggs, R.B., The Veterinarian's Companion for Common Dental Procedures, AAHA Press, Lakewood, CO, 2000.
5. Wiggs, R.B. and Lobprise, H.B., Veterinary Dentistry Principles & Practice, Lippencott Raven Publishers, Philadelphia, PA, 1997.
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7. Manfra Marretta, S., Problems in Veterinary Medicine, Dentistry, Vol. 2, No. 1, J.B. Lippencott Co., Philadelphia, PA 1990.

FELINE DENTAL EXTRACTION LAB

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In veterinary dentistry, our goal is to save teeth and maintain a healthy oral cavity if at all possible. There are indications, however, that call for extraction of teeth. Extraction of teeth can be relatively easy if periodontal disease is present and has destroyed the attachment of the tooth to the alveolar bone and gingiva, or in other cases, extractions can be difficult, time consuming, frustrating, and painful for our patients. Luckily, there are measures that can be taken to help avoid these problems. This lab will focus on extraction instrumentation, pain management, basic steps for extractions, and tips for extraction of specific types of feline teeth.

Equipment/Instrumentation:
Like any other procedure, having good quality equipment can make the job much easier. On the other hand, lack of the correct equipment, or using equipment in disrepair can make for frustrating and time consuming work. A small investment in good equipment pays big dividends in the time saved and the quality of service performed. Many of the instruments and equipment used for veterinary dentistry last for 10 to 20 years if properly maintained.
Dental radiographs are essential for extractions. They can help visualize potential problems such as fractured roots, a weakened or thin bone such as the mandible, or curved roots prior to extraction, thus avoiding potential complications. Dental radiographs also record pathology and are excellent tools for client education. They add value to the procedure and allow clients to understand why the tooth was better off removed and, in many instances, help them understand the fees associated with difficult extractions such as the large roots of canine teeth.

Other than dental x-ray equipment, here is a list of some common extraction equipment:

- 1cc syringe with 25 or 27 gauge needle
- Local anesthetic—either Lidocaine (1 hr. duration) or Marcaine (8-12 hr. duration)
- Scalpel handle
- Scalpel blade-- #10, 11, or 15
- Periosteal elevator—examples include Molt #2 or small “periotome” periosteal elevator
- Scissors—one for cutting tissue (sharp) and one for cutting suture
- Thumb forceps
- Air driven high speed handpiece
- Burs for handpiece-- #701 and 701L work well for sectioning teeth, round burs for removing bone (#1/4, #2, and #4,) surgical length if possible
- Dental elevators or dental luxators
- Small breed extraction forceps
- Suture—small size, absorbable
- Needle holders—small sizes seem to work better

Pain Management:
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such as intraligamental injections into the periodontal ligament or regional nerve blocks can be used. Local anesthetic with epinephrine can have the added benefit of vasoconstricting vessels in the extraction area, reducing intra-operative bleeding. Use caution or avoid products containing epinephrine in patients with hyperthyroidism, cardiac disease, or under halothane anesthesia. Furthermore, local anesthetic allows the patient to be maintained at a lighter plane of general anesthetic, reducing the risk of anesthetic complications.

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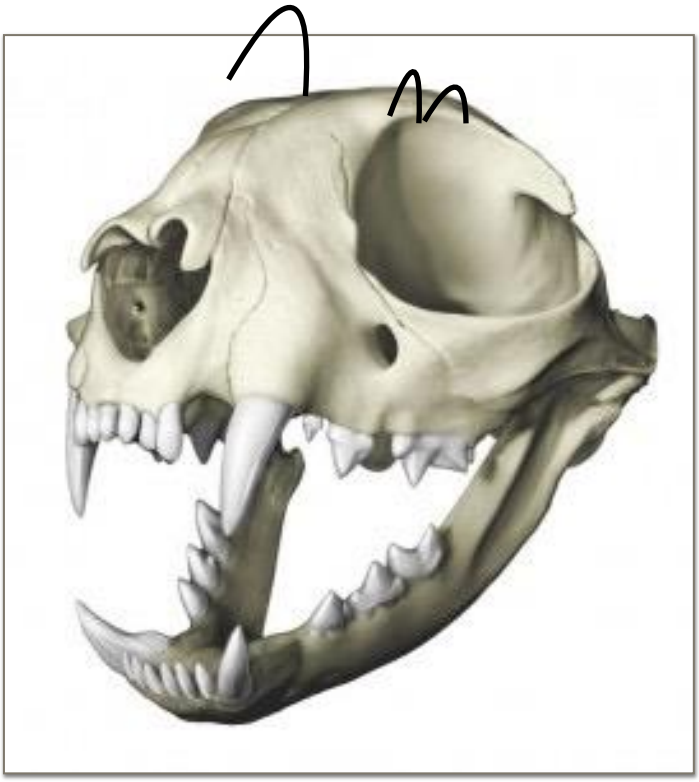

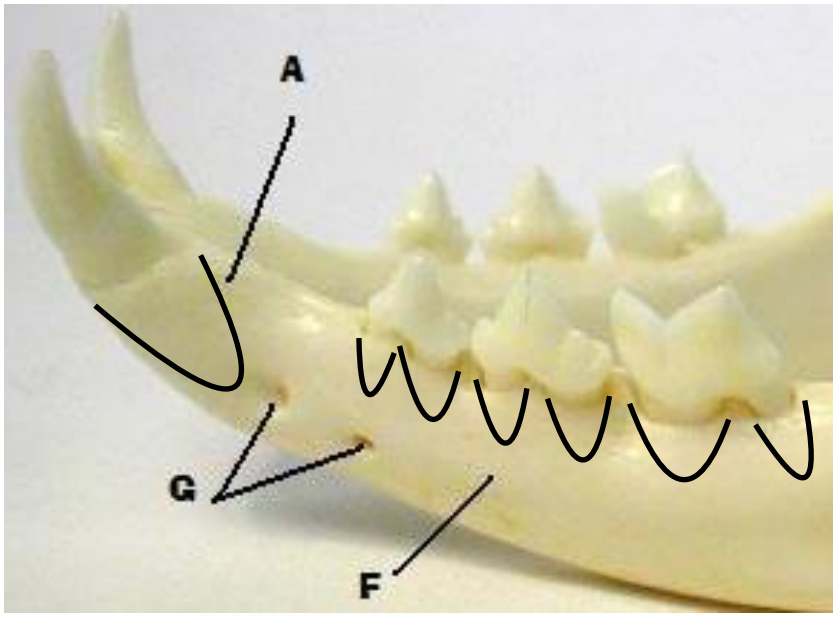

Figure 1: Alveoloplasty sites for the maxillary canine and 4th premolar.

Figure 2: Alveoloplasty sites for teeth of the mandible. Note the mental foramina.

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Avoiding and Management of Dental Extraction Complications

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Most common complications:

1. Fractured roots
2. Displaced roots
3. Oro-nasal fistulas
4. Iatrogenic mandibular fractures
5. Orbital trauma
6. Iatrogenic damage to infraorbital or mandibular arteries

Fractured roots:

Avoidance:
1. Gingival flaps
2. Removal of alveolar bone
3. Sectioning all multi-rooted teeth
4. Gentle, steady pressure when elevating until root is loose

Management:
1. Radiograph to look for root segment
2. Identify root segment clinically (use head lamp and magnification)
3. Remove alveolar bone
4. Use small bur (1/4 round, surgical length) to isolate root
5. Use gentle pressure when elevating
6. Use fine thumb forceps to remove root tips

Displaced roots:

Avoidance:
1. Isolate fractured roots as mentioned above
2. Do not use apical pressure when elevating, or use as little as possible

Management:
1. Radiograph to know general vicinity of “lost root”
2. Elevate more of the gingival flap if necessary
3. Remove more alveolar bone on buccal aspect (keep in mind local anatomy)
4. Use head lamp, magnification, and gentle air/water

5. Slowly enlarge alveolus and look for root segment as you go
6. Once root is visualized, use fine thumb forceps to remove
7. If bleeding is a problem, place gauze, go to another area to treat, then come back

Oro-nasal fistula:

Avoidance:
1. Make large gingival flaps
2. Remove adequate buccal alveolar bone
3. Use small bur to create "slots" on mesial and distal aspect of roots
4. Apply gentle, steady pressure when elevating
5. If removing maxillary canine, once loose, rotate tip of root laterally when twisting with extraction forceps

Management:
1. Enlarge gingival flap if needed
2. Radiograph to be sure all of root is removed
3. Debride any intact epithelium around alveolus
4. "Release" gingival flap tension by incising periosteal attachment
5. Undermine palatal mucosa to give good, free mucosal edge to suture to
6. Place gingival flap with no tension
7. Close with absorbable suture (monocryl or vicryl)
8. Use "double flap" if necessary

Iatrogenic mandibular fracture:

Avoidance:
1. Pre-op radiographs!!! to assess integrity of surrounding alveolar bone
2. Make gingival flap
3. Remove alveolar bone over lateral aspect of roots if needed
4. Section all muti-rooted teeth
5. Isolate root by "ditching" around it with surgical length 1/4 round ball bur
6. Use very gentle, steady pressure when elevating until root is loose

Management:
1. If fracture is suspected, stop any attempts to extract tooth further
2. Radiograph
3. Use remaining teeth/ roots to stabilize fracture (alternatively, suture any torn/incised soft tissue, place in nylon or tape muzzle and consider referral or second surgery for reduction and stabilization)

Ocular injury:

Avoidance:
1. Use all the steps we discussed to proper extraction technique

2. Be particularly careful when extraction maxillary 3rd premolar - last molar teeth
3. Keep your index finger close to the working end of the elevator
4. Do not use, or only use light apical pressure when elevating

Management:
1. If ocular damage is suspected, stop the extraction process
2. Close any lacerated or incised soft tissue
3. Consider referral for ophthalmic exam
4. Call ophthalmologist and ask if there are any medications that can be given asap

Iatrogenic damage to the infraorbital or mandibular arteries:

Avoidance:
1. Know your anatomy
2. Use previous extraction techniques to minimize chances of damage
3. For mandibular roots, when isolating root tips, remove bone mesial and distal to root tips with 1/4 round bur rather than lateral or medial

Management:
1. Apply gauze and digital pressure for 3-5 minutes
2. Once bleeding has stopped, then gently remove gauze
3. Decide if you will gently try to remove root, or close and remove at a later date

Reference:
1. My own mistakes…

Interesting Cases in Veterinary Dentistry

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· Dens Invaginatus in a Dog:

A 12yr. M/N Poodle presented for a complicated crown fracture of the right maxillary 4th premolar tooth (#108). Upon full mouth dental radiographs, another tooth, #309 was found to also have pathology. The roots were more parallel than normal and the pulp canals were wider than normal with periapical lysis at the root apices. Dens invaginatus was suspected.

Dens Invaginatus is a developmental anomalie of a tooth where the tooth structure actually infolds upon itself and in many cases infolds enough to communicate with the pulp canal. During eruption of the tooth, the pulp is protected until that area of the infold reaches the gingival sulcus/subgingival bacteria. Up until that time, the tooth develops normally, but once the bacteria are able to communicate and enter the pulp canal, pulp necrosis ensues. The result is total pulp infection with extension of bacteria and inflammatory mediators into the periapical space. Clinically, these teeth appear relatively normal, but in many instances the small fold can be seen on the vestibular (buccal) or lingual aspect of the tooth. While this can occur in any tooth, it is more common in the mandibular first molars of small breed dogs, and in many cases is bilateral. Treatment options include extraction or standard root canal therapy as long as the root has developed completely and the root integrity allows for complete cleaning and filling (obturation).[3,4] Another important consideration inn these cases is identification of the invagination and sealing of this opening to prevent ingress of bacteria into the treated tooth if treated endodontically. Neglect of these lesions or lack of recognition subjects the patient to unnecessary infection, discomfort, and potentially predisposes the mandible to pathologic fracture. Careful extraction technique is advised to prevent iatrogenic fracture of the mandible.

2. **TMJ Luxation in a cat**

A young cat presented with no known history of trauma but with malocclusion of the mandible laterally. No intra-oral trauma was noted and no caudal mandibular laxity could be palpated. The recommendation was made for anesthesia, dental and TMJ x-rays to look for TMJ luxation or mandibular/maxillary fractures. A TMJ luxation was noted.

A condition seen just enough to cloud the picture of caudal jaw fractures in cats is the temporomandibular joint (TMJ) dislocation or luxation. The TMJ is a hinge type joint made up of the condylar portion of the mandible, an intra-articular disc, and the mandibular fossa of the temporal bone. There is a fibrous attachment that forms a ligament on the lateral surface of the joint helping to hold the joint stable. In carnivores, such as cats, there is little to no lateral movement such that might be needed for grinding foods. Luxation of the condylar portion of the

mandible would seem to take great force and is somewhat amazing when it occurs without mandibular fracture.

Patients with TMJ luxation typically present with a malocclusion that prevents complete closure of the mouth. The rostral mandible will be shifted laterally and the canine teeth do not align properly, creating the malocclusion. This should be quickly differentiated, by visual exam, with periodontal disease of the maxillary canine teeth that have luxated medially preventing closure of the mouth. The other differential diagnosis is a caudal mandibular fracture. As a general rule of thumb, most feline TMJ luxations move the condylar process rostro-dorsal to the temporal fossa deviating the front of the mandible AWAY from the side of the luxation. To the contrary, most caudal mandibular fractures allow compression of the fracture segments and deviation of the rostral mandible TOWARD the side of the fracture. Caudal instability of the mandible could be a sign of either problem and is not necessarily diagnostic. Open mouth locking is usually NOT a sign of TMJ luxation, rather more likely a flaring of the coronoid process with entrapment of the coronoid process under the zygomatic arch.

Definitive diagnosis is made with either radiographs or computed tomography (CT) of the TMJ region. While CT of the TMJ region is going to be the most reliable diagnostic test, in many instances, TMJ radiography can reveal the luxation location, can be more accessible, and more economical. The limitation of radiography is the inability to see possible smaller fractures. Dorsoventral/ventrodorsal with right and left lateral oblique views of the TMJ are necessary to evaluate the TMJs and when positioning for the lateral obliques, place the patient in lateral recumbency, elevate the nose to level and rotate the head 10 degrees so the down side is slightly more ventral to the upper side when the radiograph is exposed.

Once the side of the TMJ is confirmed, replacement of the condyle in the fossa involves using a dowel (a pencil) positioned between the carnassial teeth to act as a fulcrum while gentle digital pressure is applied to the rostral mandible as if you were pushing the mouth closed. The condyle should lightly “snap” back into the normal position. Radiographs or another CT can confirm the condyle is in proper position. I prefer to apply mild intrusive force by pushing on the rostral mandible toward the back of the skull to dispel any swollen soft tissue and hold this for 2-3 minutes. The patient is recovered and discharged with instructions for soft diet only for 3-4 weeks. In recurring cases, tape muzzle, dental bonding of the canine teeth, esophagostomy tube feeding, open reduction or condylectomy may be indicated.

3. Chronic Nasal Discharge in a 9 month old Schnauzer

A 9 month old M/N Schnauzer presented for a 3 month history of nasal discharge. He had been kickedd in the headd by a horse at 3 months of age, but no major problems were noted at the time. On oral examination deciduous canine teeth were still present at the site the permanent maxillary canine teeth should occupy. Dental radiographs were taken which reveal displaced permanent tooth buds in the nasal passages. A rhinotomy was created though the buccal mucosa at the right and left maxillary canine location and the tooth buds were removed.

4. Locked jaw in a 12 week old puppy

A puppy was adopted from a local animal shelter and after the new owners had this puppy 24 hours noticed she could not open her mouth more than a few millimeters…could not eat dry kibble. There was a history of other littermate being killed by the mother of the puppies at an early age. Skull radiographs provided to us revealed rostral displacement of the left coronoid process and possible bony callus at the distal aspect of the left maxilla. CT scan confirmed the suspicions. A diagnosis of TMJ pyseudoankylosis was made due to bony callus formation at left

distal maxilla, preventing movement of the mandible. A surgical approach to the bony callus was made via a skin incision just ventral to the zygomatic arch. The callus was identified and removed, freeing the mandible to move nearly full extent of range of motion. Possible post-operative complication included the chance of re-ankylosis. Soft diet and slow physical therapy was utilized and TMJ range of motion continued to be normal 8 months post-op.

5. Locked jaw in an 8 month old kitten

Similar to the above case, but instead of TMJ pyseudoankylosis, this patient had true TMJ ankylosis of the left TMJ. Dental radiographs revealed the abnormal bony callus and CT was not necessary to make surgical decisions. A surgical approach to the left TMJ was made and the abnormal bony callus was removed via left TMJ condylectomy / mandibular fossa osteotomy with rongeurs. This patient had normal TMJ range of motion 3 months post-op.

6. Mandibular mass in an 18 month old Golden Retriever

Initial presentation found this patient to have a large firm swelling within the left rostral mandibular bone in the rostral premolar region. The recommendation for incisional biopsy was made. Following dental radiographs, a characteristic pattern eas recognized as a compound odontoma. Odontomas are benign abnormal division of cells of tooth origin. There are two specific types of odontomas, compound and complex. The compound odontoma will radiographically appear like a sac of multiple teeth whereas the complex odontoma will appear radiographically as a soft tissue density mass within the bone. Both are treated the same, open exploration with curettage of all contents and cavity lining. Submission of the contents and/or lining is advised to confirm the clinical diagnosis.