Decision Making and Extraction Techniques in Dogs and Complications Management

Decision making and techniques to simplify dental extractions in dogs have been described.\textsuperscript{1-5} Proper perioperative planning and decision making regarding canine extractions can improve surgical outcome. It is important to properly assess the canine patient prior to the performance of extractions. This includes complete general physical and oral examinations and appropriate preoperative blood work. Once the patient has been properly assessed it is important to select an appropriate anesthetic protocol that will provide the canine dental patient with adequate perioperative pain management.

Oral examination in the awake canine patient is similar to the oral examination in the awake feline patient. Abnormalities detected are discussed with the owner with the stipulation that additional abnormalities may be detected in the anesthetized patient. Oral examination in the anesthetized canine patient begins with a thorough oral examination including evaluation for missing or supernumerary teeth, malformed teeth, proper occlusion, periodontal probing and exploration of the teeth with a dental explorer to detect pulpal exposure, worn teeth and dental caries. Abnormalities are noted on the canine dental chart.

Dental radiography is an important tool in the decision making process in canine dental patients. Dental radiography can help determine the most appropriate treatment modality in canine teeth affected with periodontal disease, endodontic disease, dental caries and other lesions. A dental radiograph taken prior to performing a difficult extraction will provide the veterinarian with important information regarding the tooth. Radiographic evaluation of the tooth will determine if other treatment options may be possible so that the owner can be offered alternatives to extraction. In cases of severe periodontal or endodontic disease extraction may be the best treatment option for the patient. Dental radiographs prior to extraction will also reveal structural abnormalities that might be present in the tooth or surrounding bone. These structural abnormalities include: severe periradicular bone loss secondary to periodontal or endodontic disease, supernumerary roots, abnormal root angulation including convergent roots and excessive curvature of the apical portion of the root, ankylosis and hypercementosis. Knowledge of these structural abnormalities prior to initiation of the extraction provides important information regarding the most appropriate technique for the extraction and will help reduce the incidence of complications.

A high-speed handpiece with fiberoptics is extremely helpful when performing surgical extractions in dogs. The fiberoptic handpiece provides a light source directly on the surgical site. Burs utilized frequently include a variety of round burs for the removal of buccal bone and tapered fissure burs for sectioning multi-rooted teeth. Essential hand instrumentation for performing canine extractions have been previously described.\textsuperscript{1-5} Hand instrumentation specifically designed for canine extractions is available through numerous veterinary supply companies. Instruments for canine extractions may be packaged together in a canine extraction pack and steam sterilized prior to each use. Instrumentation in canine extraction packs include: scalpel handle upon which a #15 blade can be placed prior to surgery, a periosteal elevator, a soft tissue retractor, a variety of dental elevators and luxators, extraction forceps, needle holders, Adson tissue forceps, suture scissors and an iris scissors for cutting soft tissue. A small root forceps is also helpful for reaching down into an alveolus and obtaining a firm grasp on a loose root tip. It is imperative to routinely sharpen dental instruments to insure optimal functionality.
The dental formula in the adult dog is: 2 (I 3/3, C1/1, P4/4, M2/3) = 42. The incisors and canine teeth all have one root. The 1st premolars and the lower 3rd molars have one root. The upper 2nd and 3rd premolars and the lower 2nd, 3rd 4th premolars and 1st and 2nd molars have two roots and the upper 4th premolar and 1st and 2nd molars have 3 roots. Knowledge of the location of the furcation of the teeth will permit accurate sectioning of teeth during surgical extractions.

There are several techniques for performing extractions in the dog. These techniques include a simple, multi-rooted and surgical extraction.

The incisors, the maxillary and mandibular 1st premolars and the mandibular 3rd molar are generally small single rooted teeth in the dog and can be usually be removed using simple or closed extraction techniques. Simple or closed extraction techniques have been previously described. The procedure is initiated by cutting the gingival attachment around the whole circumference of the tooth using a No. 11 scalpel blade on a handle or a sharp luxator. A luxator that matches the curvature of the tooth is selected and is placed into the gingival sulcus at a slight angle to the tooth and advanced into the periodontal ligament space and worked around the entire circumference of the tooth using gentle apical pressure. The operator may now elect to continue the extraction using a dental elevator or continue using a luxator. A dental elevator may be used once adequate space has been created for the thicker tipped instrument. An appropriate sized elevator is selected, placed in the periodontal ligament space and worked around the tooth with a gentle rotational pressure held at each point for 10-15 second to help break down the periodontal ligament. Once the tooth becomes loose it can be removed digitally or gently grasped with a dental extraction forceps placed as far apically on the tooth as possible and with a gentle rotational movement of the forceps in the long axis of the tooth, the tooth may be rotated and removed from the alveolus.

Extraction of multi-rooted teeth in dogs begins by cutting the gingival attachment to the tooth with either a No. 11 or 15 scalpel blade on a handle or an appropriately sized sharp luxator. The furcation(s) of the tooth are located using visual inspection of the gingiva and alveolar crest. Furcations may be located by observing where the gingiva and alveolar crestal bone raises slightly coronally. Removal of a small amount of bone in this area with a round bur will help in visualizing the furcation. Once the furcation is located, the tooth is sectioned by placing a tapered fissure bur (#701 or #701L) at the furcation and sectioning the tooth through the crown. One sectioning is performed for 2 rooted teeth and a total of two sectioning are required in 3 rooted teeth to divide the tooth into multiple single units. A V-shaped sectioning of the tooth at the furcation will help provide better assess to each root. To confirm that the tooth has been successfully sectioned, a dental elevator is placed between the segments and gently rotated. If the segments move slightly apart then the sectioning is complete; if the segments do not move following slight leverage between the cusp segments then the sectioning is likely to be incomplete and additional burring is necessary to complete the sectioning. Once the sectioning is complete the individual roots are extracted independently as previously described for simple extractions.

A complicated or surgical extraction technique is generally reserved for teeth that are difficult to extract because of their large root structure including the canine teeth, mandibular 1st molars and the maxillary 4th premolars. A surgical extraction may also be performed when teeth are ankylosed or when attempting to retrieve a broken root tip. The teeth most commonly requiring surgical extractions include the canine teeth and the carnassial teeth.
Surgical extraction of the maxillary canine tooth is initiated by making divergent incisions mesial and distal to the canine tooth and creating a mucoperiosteal flap. The buccal alveolar bone is removed as needed with a round bur to easily extract the tooth with luxators and dental elevators. Care should be taken to avoid creating an oronasal fistula during the extraction. The periosteal layer of the flap is incised apically to relieve tension on the flap prior to closure. There are two approaches for the surgical extraction of the mandibular canine teeth including the labial and lingual approach. The labial approach utilizes a mucoperiosteal flap located on the labial aspect of the tooth while a lingual approach utilizes a lingually located flap. Equal amounts of alveolar bone are present buccally and labially so there is no advantage of one technique over the other with regard to bone removal. The mental artery, vein and nerve exit through the mental foramen located near the labial aspect of the apex of this tooth. A lingual approach avoids potential damage to these structures, however, visualization of the surgical site is more challenging with the lingual approach.

When performing a mucoperiosteal flap for the surgical extraction of the maxillary 4th premolar several structures should be carefully avoided. When making the mesial (rostral) portion of the incision the infraorbital artery, vein and nerve should be avoided as they exit the infraorbital canal immediately rostral to the periapical bone of the mesiobuccal root of the maxillary 4th premolar. These structures can be avoided by digitally retracting them dorsally and not extending this incision too far apically. When making the distal (caudal) part of the incision, the parotid and zygomatic salivary duct papillae should be visualized and avoided. After raising the mucoperiosteal flap the furcations are located using a round bur. The tooth is then sectioned through the furcation between the mesiobuccal and distal roots with a #701L tapered fissure bur from the furcation through the crown. Alveolar bone over the distal root is removed as needed to remove the distal root. A V-shaped segment can be removed from the cusp overlying the furcation. Alternatively some operators prefer to amputate part of the remaining portion of the crown. The bur is placed in the furcation perpendicular to the tooth at the base of the palatal wall of the mesiobuccal cusp to section between the mesiobuccal and palatal roots. The alveolar bone over the mesiobuccal root is removed as needed to remove the mesiobuccal root. The interradicular bone between the mesiobuccal and palatal roots can be removed as needed to expose the palatal root. When extracting the palatal root it is important to direct the luxator in a slightly palatal direction to follow the palatal direction of the apex of this root. The extraction site is débrided, flushed and closed in a routine manner.

Surgical extraction of the mandibular 1st molar is initiated with a mucoperiosteal flap with two divergent releasing incisions on the mesial and distal buccal aspect of the tooth. The mucoperiosteal flap is raised and the furcation is located and sectioned by removed a V-shaped section of the cusp overlying the furcation. The distal and mesial edges of the cusps of the tooth may be removed to provide straight line accesses to the periodontal ligament spaces. This is particularly helpful in teeth that are crowded. Buccal alveolar bone is removed as needed to extract the segments. Rough edges of the alveolar bone are reduced with a large round bur, the extraction site is débrided and flushed with sterile saline. The periosteal layer of the flap is released and the flap is closed in a simple interrupted pattern with a monofilament absorbable suture material.

Complications Associated with Extractions

Complications associated with extractions include the following: root fracture, hemorrhage, delayed wound healing and infection, oronasal fistula, ocular injuries, salivary duct injury, misplacement of roots fragments into the nasal cavity or into the mandibular canal, damage to adjacent teeth and
mandibular fracture. Careful extraction techniques and appropriate perioperative management can help minimize these complications.

Surgical techniques for extraction of fractured root tips has been described. When a tooth root fractures it should be determined if the root must be retrieved and in most cases root fragments should be completely removed. Roots of endodontically and periodontally diseased teeth must be removed. However, teeth undergoing severe bony replacement/resorption may be best treated conservatively. When extracting fractured tooth roots a mucoperiosteal flap is raised and some of the buccal alveolar bone over the retained root is removed. When attempting to localize the fractured root the operator should examine the extracted coronal segment to mentally determine the anatomic features of the residual root structure. In addition, the operator should look for a white, hard, non-bleeding structure with a central pulpal red or black spot. Dental radiographs can be extremely helpful in locating fractured root tips. Other techniques that have been described include using the flat end of a cylindrical diamond bur on a high-speed handpiece to flatten the coronal aspect of the fractured root and a small area of the surrounding bone until the root is clearly visible in cross-section. A small round bur (# 1/2) is used to create a “gutter” or space around the root to place an elevator into the expanded periodontal ligament space. It is important to locate the periodontal ligament space while elevating a root because failure to locate this space often results in inappropriate placement of the dental elevator or luxator either on the alveolar bone or tooth. Elevation on the alveolar bone or tooth is ineffective and until the dental elevator or luxator is directed into the periodontal ligament space removal of the root will not proceed efficiently. A luxator is placed in the space around the root and then a dental elevator is gently rotated and held for 10-20 seconds around the entire circumference of the root. The periodontal ligament space will fill with a small amount of blood and can be observed as a thin red line located between the alveolar bone and the root. The dental elevator or luxator should be directed into this space to permit more effective elevation and efficient extraction of the root until it becomes loose and is easily extracted. The surgical site is débrided, flushed and closed routinely.

References:

Decision Making and Extraction Techniques in Cats and Complication Management

Several dental problems in cats may require a variety of extraction techniques including simple, multi-rooted and surgical extractions. Crown-amputation may be an appropriate treatment option in feline patients with severe tooth resorption. The veterinary dental team must be aware of the criteria for proper assessment of these lesions so that appropriate treatment can be provided. It is also important for the dental team to be aware of treatment options for cats with stomatitis so that appropriate recommendations can be provided.
Decision making and techniques to simplify dental extractions in cats have been previously described.\textsuperscript{1-5} Proper perioperative planning and decision making regarding feline extractions can improve surgical outcome.

**Preoperative Considerations in the Feline Dental Patient**

It is important to properly assess the feline patient prior to the performance of extractions. This includes complete general physical and oral examinations and appropriate preoperative blood work. Once the patient has been properly assessed it is important to select an appropriate anesthetic protocol that will provide the feline dental patient with adequate perioperative pain management.

**Oral Examination in the Awake and Anesthetized Feline Patient**

It may be difficult to perform a thorough oral examination in the awake feline patient, however, it is important to attempt to assess the oral cavity in the cat as completely as possible to help determine the general oral health of the patient. It must be remembered that all of the oral and dental lesions will not be readily apparent in the awake feline patient and a thorough oral examination including dental radiographs under anesthesia will be necessary to detect the full extent of the dental lesions. An oral exam is initiated by placing both hands gently around the patient’s head and neck and then gently parting the lips with the thumbs to visualize the buccal aspect of the canine teeth and cheek teeth on each side. The incisor and canine teeth may be visualized from the front of the patient using the index fingers and thumbs to retract the lips. The maxilla is then visually assessed for any evidence of asymmetry or swelling. The eyes and nostrils are evaluated for any signs of asymmetry or discharge. The mandibles are then palpated for any evidence of swelling or asymmetry. The mouth is then gently opened by placing the index finger and thumb of the nondominant hand just below the zygomatic arches and tilting the patient’s nose dorsally and then carefully placing the tip of the opposite index finger over the lower incisor teeth and gently pushing ventrally to open the mouth to permit visualization of the tongue, palate and pharynx. The thumb of the dominant hand is then placed in the interdental space with the index finger still on the lower incisors to displace the tongue dorsally to permit examination of the ventral aspect of the tongue. Abnormalities detected are discussed with the owner with the stipulation that additional abnormalities may be detected in the anesthetized patient.

Oral examination in the anesthetized feline patient begins with a thorough oral examination including evaluation for missing or supernumerary teeth, malformed teeth, proper occlusion, periodontal probing and exploration of the teeth with a dental explorer to detect pulpal exposure and resorptive lesions. Abnormalities are noted on the feline dental chart.

**Dental Radiography in the Feline Patient Prior to Extraction**

Dental radiography is an important tool in the decision making process in feline dental patients. Dental radiography can help determine the most appropriate treatment modality in feline teeth affected with periodontal disease, endodontic disease and resorptive lesions.

There are several radiographic changes associated with feline periodontal disease that indicate that extraction is required. Dental radiographs demonstrating less than 50% of attachment remaining on any mobile tooth indicates that extraction is indicated. In addition if dental radiographs indicate that there is loss of attachment to the apex of a single-rooted tooth or loss of attachment to the apex of any root of a multi-rooted tooth then an extraction is indicated.
There are several radiographic changes associated with feline endodontic disease that are indicative of the need for extraction or endodontic treatment. Radiographic changes associated with endodontic disease or disease of the pulp include loss of tooth structure to the pulp of the tooth, asymmetrical endodontic canals, periapical lysis or apical lysis.

There are several radiographic changes associated with resorptive lesions. Dental radiography is extremely important in the assessment of resorptive lesions since the selection of appropriate treatment is based on proper evaluation of dental radiographs. Feline teeth with advanced root resorption, without periodontal or endodontic lesions are good candidates for crown amputation with intentional root retention. Conversely, a tooth with a resorptive lesion that has a well-defined periodontal ligament space, bone loss due to periodontitis, or a periapical lesion evident on radiographs requires standard extraction techniques with complete removal of the roots. In individual feline teeth in which one root has an advanced root resorptive lesion and another root has a well-defined periodontal ligament space it is acceptable to perform a crown amputation with intentional root retention on the root that has severe resorption and perform a routine extraction of the root that has a well-defined periodontal ligament space. A complete description and images of the various types of resorptive lesions can be found on the American Veterinary Dental College’s web site under the nomenclature tab at the following address: avdc.org. Additional information can also be found on the information for veterinarians tab.

Proper Equipment and Instrumentation for Feline Extractions

A high-speed handpiece with fiberoptics is extremely helpful when performing surgical extractions in cats. The fiberoptic handpiece provides a light source directly on the surgical site. Burs utilized frequently include small round burs for the removal of buccal bone and tapered fissure burs for sectioning multi-rooted teeth. Essential hand instrumentation for performing feline extractions have been previously described. Hand instrumentation specifically designed for feline extractions is available through numerous veterinary supply companies. Instruments for feline extractions may be packaged together in a feline extraction pack and steam sterilized prior to each use. Instrumentation in feline extraction packs include: scalpel handle upon which a #15 blade can be placed prior to surgery, a small feline periosteal elevator, a soft tissue retractor, a variety of dental elevators and luxators, small extraction forceps, small needle holders, Adson tissue forceps, suture scissors and an iris scissors for cutting soft tissue. A small root forceps is also helpful for reaching down into an alveolus and obtaining a firm grasp on a loose root tip. It is imperative to routinely sharpen dental instrumentation to insure optimal functionality.

Anatomic Features of Feline Teeth

The dental formula in the adult cat is: 2 (I 3/3, C1/1, P3/2, M1/1) = 30. The anatomy of the mouth and teeth of the cat has been previously described. Feline teeth are much smaller and narrower than canine teeth. All the incisors and canine teeth have one root. The maxillary second premolar is a small single-rooted tooth. The maxillary 3rd premolar has 2 roots with a supernumerary root sometimes present, the maxillary 4th premolar has 3 roots and the maxillary 1st molar is very small with two roots that may be fused. There are 3 mandibular cheek teeth. The 3rd and 4th premolars each have two symmetrical roots and the 1st molar has two asymmetrical roots with a large mesial root and a small distal root.
Techniques for Performing Feline Extractions

There are several different techniques for performing feline extractions. These techniques include a simple extraction, multi-rooted extraction, single-rooted surgical extraction, partial or full-mouth extractions for the treatment of feline stomatitis, and crown amputation with intentional root retention for the treatment of feline resorptive lesions.

Simple or Closed Extraction

The incisors, the maxillary 2nd premolar and the maxillary molar teeth are generally small single rooted teeth in the cat and can be removed using simple or closed extraction techniques. Simple or closed extraction techniques have been previously described.1-5 The procedure is initiated by cutting the gingival attachment around the tooth using a No. 11 scalpel blade on a handle or a sharp luxator. A luxator that matches the curvature of the tooth is selected and is placed into the gingival sulcus at a slight angle to the tooth and pressed into the periodontal ligament space and worked around the entire circumference of the tooth using gentle apical pressure. The operator may now elect to continue the extraction using a dental elevator or continue using a luxator. A dental elevator may be used once the tooth is loose and has been created for the thicker tipped instrument. An appropriate sized elevator is selected, placed in the periodontal ligament space and worked around the tooth with a gentle rotational pressure held at each point for 10-15 seconds to help break down the periodontal ligament. Once the tooth becomes loose it can be removed digitally or gently grasped with a small dental extraction forceps placed as far apically on the tooth as possible and with a gentle rotational movement of the forceps in the long axis of the tooth, the tooth may be gently rotated and removed from the alveolus.

Multirooted Extraction

Extraction of multirooted teeth in cats requires additional consideration because of the tendency for these roots to fracture during extractions. These teeth can be removed in a similar manner as described for dogs. A modified technique for extracting multirooted teeth in the cat has been reported.2 This technique involves raising both buccal and lingual flaps and removing adequate alveolar bone to expose the furcation. The furcation is then sectioned using a #2 round bur making two cuts from the furcation at 45°, one distally and one mesially removing a significant portion of the crown leaving only a small portion of the crown mesially and distally. A size #2 round bur is then used to remove the interradicular bone between the mesial and distal roots to the apical region of the roots without invading the nasal cavity or mandibular canal. This results in support of the roots by 3 sides. An appropriately sized luxator or elevator can be eased into the interradicular space created by the bur and into the periodontal ligament of the roots to gently remove the roots independently. Additional buccal bone may be removed as necessary. Sharp edges of bone are removed with a small round bur, the surgical site is flushed and the flap is closed with 5-0 or 6-0 Monocryl or Vicryl Rapide on a small reverse cutting needle.

Single-Rooted Surgical Extraction

The canine tooth in cats may require a surgical extraction. The maxillary canine tooth can be removed through a labial flap with two releasing incisions with a broad base. Minimal bone is removed over the labial aspect of the tooth to permit delivery of the tooth using the luxators and dental elevators as previously described. Extraction of the mandibular canine tooth in the cat can be performed using a labial, lingual or alveolar margin approach. The labial approach utilizes a labial flap with labial bone
removal, the lingual approach utilizes a lingual approach with lingual bone removal and the alveolar margin approach uses a dorsal approach to the canine root through a single incision over the root of the tooth from the distal aspect of the canine tooth distally toward the mesial aspect of the mandibular 3rd premolar. In this approach the bone is removed over the root along the alveolar ridge in the edentulous space between the canine tooth and the 3rd premolar. Care must be taken when elevating this root to direct the elevator along the sides of the root and not straight down the distal aspect of the tooth since this type of elevation will direct the elevator into the root of the canine tooth instead of into the periodontal ligament space. Care must also be taken when extracting the mandibular canine teeth in cats to not apply excessive rotational forces with the elevator on the lingual aspect of the root since this may result in mandibular fractures.

**Partial or Full-Mouth Extractions for the Treatment of Feline Stomatitis**

In cases of feline gingivostomatitis in which medical management is unsuccessful, extraction of all premolars and molars or full-mouth extraction is the treatment of choice. This is facilitated by making a full-thickness gingival flap in each quadrant, using a small feline periosteal elevator to elevate the lingual and/or palatal and buccal aspects to provide adequate exposure to the underlying bone. The buccal bone is removed as needed, the teeth are sectioned and removed as previously described. The rough edges of bone are removed with a small round bur, the alveoli are curettaged, the surgical site is flushed and the surgical site closed without tension.

**Crown Amputation with Intentional Root Retention for Resorptive Lesions**

Properly screened teeth with feline resorptive lesions can be treated by crown amputation with intentional root retention. Pre-extraction radiographs are imperative in case selection. Teeth with advanced root resorption, without periodontal or endodontic lesions, are good candidates for crown amputation with intentional root retention. Teeth with an intact periodontal ligament and no severe root resorption or teeth with periodontal or endodontic lesions or cats with stomatitis require routine extractions. The procedure is initiated by making a small mucogingival flap and amputating the crown with a small round diamond burr on a high-speed handpiece. Care must be taken to avoid trauma to adjacent teeth with the burr. The site is checked with a dental explorer to insure complete amputation of the entire crown. Any residual crown and irregular alveolar bone is removed with the round bur. The residual pulp in the surgical will bleed on appropriately screened teeth. The site is flushed and closed.

**Complications Associated with Extractions**

Complications associated with extractions include the following: root fracture, hemorrhage, delayed wound healing and infection, oronasal fistula, ocular injuries, salivary duct injury, misplacement of roots fragments into the nasal cavity or into the mandibular canal, damage to adjacent teeth and mandibular fracture. Careful extraction techniques and appropriate perioperative management can help minimize these complications.

**References:**

