In: **Recent Advances in Small Animal Dentistry**, D. T. Carmichael (Ed.)
Publisher: International Veterinary Information Service (www.ivis.org), Ithaca, New York, USA.

Oral Surgery: Dental Extractions (18-Jan-2001)

B. H. Colmery

Michigan Veterinary Specialists, Southfield, Michigan, USA.

Summary
Extraction of diseased and malformed teeth is an essential part of veterinary oral surgery. Indications for extraction include: end-stage periodontal disease, end-stage endodontic disease, pulp exposure when endodontic treatment is not elected, malocclusions, crowding, retained deciduous teeth, feline odontoclastic resorptive lesion ("neck lesion"), trauma, plaque-intolerant animals, and disarming. Extracting teeth is made less difficult when the general principles of oral surgery are understood and practiced.

Oral Surgery: Dental Extraction

Indications for Dental Extraction

Extraction of diseased and malformed teeth is an essential part of veterinary oral surgery. Indications for extraction include: End-stage periodontal disease, end-stage endodontic disease, pulp exposure when endodontic treatment is not elected, malocclusions, crowding, retained deciduous teeth, feline odontoclastic resorptive lesion ("neck lesion"), trauma, plaque-intolerant animals, and disarming.

General Comments on Extraction Techniques

Extracting teeth is made less difficult when the following principles are understood:

- Pain management must be addressed. Various pain management techniques must be used including: medical management (pre-surgical and post-surgical medications), regional nerve blocks, and local nerve blocks.
- The top (coronal) 1/3 of the alveolar bone surrounding the tooth has 2/3rds of the holding power.
- Periodontal fibers are not designed to withstand slow, continuous torque.
- Multi-rooted teeth are transformed into single-rooted teeth.
- Gingival preservation is paramount.
- Complete extraction of root confirmed by radiograph.
- Closure of alveolus to maintain blood clot.

Non-surgical Extraction

The techniques of extraction include surgical and non-surgical procedures. Non-surgical extraction is accomplished with simple elevation and traction. Prior to any attempts at extraction, dental radiology is imperative. Veterinary dental radiology techniques are well described in other textbooks and the reader is referred to the suggested reading list if unfamiliar with dental radiology [1,2].
Non-surgical extraction is performed by placing gentle traction and rotation on the affected tooth with dental forceps or needle holders. The alveolus is gently debrided removing excessive fibrous tissue (not risking fracture). Once clean, the alveolus can be filled with osteoinductive materials, impregnated resins, or the newer bone morphogenic materials. After filling, the alveolus is closed using 4 - 0 or 5 - 0 absorbable suture material. Home care includes antibiotic therapy, pain management, and soft diet.

Surgical Extraction

Surgical extraction is performed on non-mobile teeth with normal or near normal attachment levels. Each step is equally important and short cuts generally end up as surgical misadventures.
The techniques for surgical extraction include:

- Preoperative intraoral dental film
- Flap creation
- Removal of alveolar bone (osteoplasty)
- Isolation of roots (sectioning)
- Elevation of roots
- Post-extraction intraoral dental film
- Alveloplasty (if required)
- Closure

As with non-surgical extraction, dental radiographs are taken preoperatively to assist in extraction planning. Radiographs helps document the need for extraction, making the procedure defensible in a court of law, and also guide the surgeon in placing flaps, coronal sectioning angles and elevation points.
Following radiographs, the next step is the creation of a surgical flap. The surgeon must plan ahead when cutting tissue to preserve as much attached gingiva as possible. If attached gingiva is lost, closure becomes difficult. Extraction flaps are created using the following guidelines:

- Releasing incisions through attached gingiva and mucosa are on a diagonal diverging apically.
- Periosteal elevators are used to reflect attached gingiva, oral mucosa, and periosteum.
- The incision should extend through the gingiva or mucosa and periosteum to the bone.

After the incisions are made, a Molt periosteal elevator (or equivalent) is used to elevate the attached gingiva from the bone. Care is used to prevent shredding the gingiva (especially in felines) during this step. Molt periosteal elevators are spoon-shaped instruments with a sharp cutting surface on a round edge. As the attachment is cut the rounded edge deflects the tissue away from the bone atraumatically. When done properly the attached gingiva and mucosa are in one piece without perforations.
Once the attached gingiva is reflected, the crestal bone is removed with a round or pear-shaped bur. Sufficient bone should be removed to significantly weaken the holding power of the periodontium. Problems such as root ankylosis can necessitate full-length removal of bone before the tooth root can be completely removed. A good rule of thumb is to remove one third of the crestal bone in an apical direction. Generally, the buccal or labial surfaces are the only areas that require reduction. On rare occasion the palatal or lingual surfaces also require reduction. Occasionally, a notch is cut on the mesial and distal edges of the tooth in the crestal bone to allow a "purchase" with the root elevator.
One of the key steps of extraction is the sectioning of multi-rooted teeth. Because tooth roots diverge in animals, extracting them as one unit is nearly impossible. By cutting the crown through the furcation, the veterinary dentist is able to extract each root on an individual basis. The three rooted teeth (maxillary 4th premolars and maxillary molars) require two cuts, the remaining multi-rooted teeth require a single cut. The author discourages the use of diamond wheels or crosscut fissure burs and encourages the use of round or pear-shaped burs.
The hallmark of successful root elevation is patience. More extraction misadventures occur from impatience than any other cause. Periodontal fibers are designed to withstand sharp, repetitive forces (much like those of mastication), but not those of slow continuous torque. The idea behind elevation is just that - elevation; not prying, gouging, crunching, or punching. The proper use of an elevator is the application of rotational forces placed on the tooth in an effort to lift the tooth out of its alveolus. Because the periodontal fibers break slowly, bundle by bundle, the forces should be applied for 20 to 30 seconds at a time. The elevator is reapplied at a different location on the tooth and the forces are again applied for 20 to 30 seconds (the "Thirty-Second Rule"). The advantage of "slowing down" is that apical bleeding occurs into the alveolus, helping to "push" the tooth out of its home. The hydraulics can be quite powerful and this phenomena should be used. If there is insufficient purchase on the tooth, a bur is used to cut a notch in adjacent bone to provide sufficient space for the elevator blade to fit between bone and tooth.
After sufficient bone removal and elevation, the tooth root should become mobile. Small dental forceps (or better yet needle holders) are used to grasp the tooth crown and then rotate the tooth on its long axis. The same principle of patience is used in that the tooth is rotated to the point of resistance and held for 20 to 30 seconds. The rotation is reversed and again held for 20 to 30 seconds. By using slow, continuous forces, the fibers are torn and the tooth becomes loose enough for gentle traction to remove it from its socket.
After the roots have been successfully removed, a post-extraction radiograph will confirm and document your success. The alveolus can then be treated with an alveolar augmentation agent (as previously discussed) and sutured closed with 4 - 0 or 5 - 0 absorbable suture material. For patient comfort and knot security, simple interrupted inverted sutures are used to secure the attached gingiva and oral mucosa. The releasing incisions are closed in a similar manner. The finished site should be smooth with only single strands of suture material visible.

Techniques for Extraction of Specific Teeth

Mandibular First Molars - mandibular first molars can be a challenge to extract if the principles of extraction are ignored. The key is radiography and patience. Dental radiographs will reveal existing or impending pathologic mandibular fractures and root malformations (dilacerations). Releasing incisions for flaps are placed on the labial surface of adjacent tooth roots both mesially and distally starting through the attached gingiva and diverging apically about one half the length of the root. The gingival epithelial attachment is incised, and the attached gingiva and oral mucosa are elevated from the mandible.

Following flap creation, a small round bur or pear-shaped bur is used to lower the crestal bone to at least the level of the furcation. This is done both labially and lingually. Care is used to keep the soft tissue away from the bur. Next the bur is used to section the tooth starting in the furaction and proceeding coronally just mesially to the table surface of the distal root. If needed, a groove is cut around the tooth root to allow placement of the elevator tip. This allows the tip to make a "purchase" on the tooth crown to aid in the displacement of the tooth root in its alveolus.

In cases with significant bone loss, elevators are not used. Instead, needle holders or small forceps are employed to apply gentle rotational torque to the tooth root. This is critical if the surgeon wishes to avoid an iatrogenic fracture during extraction. The rotational forces are applied first in one direction, held for thirty seconds, then changed to the opposite direction, held for thirty seconds and repeated. This step is repeated until the periodontal fibers are broken and gentle traction extricates the tooth. If the tooth has significant ankylosis (as seen radiographically), the surgeon may need to circumferentially cut around the tooth root with a small round or diamond bur. Care must be taken to avoid the mandibular canal. Penetration not only creates visual impairment of the extraction site (bleeding), but inflicts lingering pain as the mandibular nerve is disturbed. Face pawing is a common sign when adequate pain control is not used.

Maxillary Canine Teeth - the upper canine teeth are not difficult to extract when proper surgical techniques are employed. The steps are similar to the previous descriptions with special care given to avoid oral nasal fistula formation.

Extraction of the upper canine tooth starts with a radiograph. This reveals any abnormalities that may need to be addressed and helps eliminate surgical surprises. Releasing incisions are made over the lateral incisor and first premolar directed apically and diverging. Next, the diastemas between the lateral-incisor-and-canine, and canine-and-premolars are incised along the alveolar ridge. As before, a molt periosteal elevator is used to reflect the attached gingiva and oral mucosa off the buccal plate. And as before, great care is used to not shred the tissue.

Once reflected, a small round bur or pear-shaped bur is used to cut a relief site on the buccal plate over the tooth root. As a rule, about one third of the tooth's buccal plate can be removed without any complications. It is easiest to bur along the mesial and distal surface of the root, then cross over the root to connect both sides. It is not necessary to bur deeply in that the buccal plate is thin (0.5 to 1.0 mm), and over-burring weakens the tooth root, leading to root fracture during extraction. In addition to the buccal side, some animals need to have a purchase groove cut into the palatal side of the tooth. Generally this needs only be 1 - 3 mm in depth.

An elevator is placed on the palatal side of the tooth and the crown is gently displaced buccally. Next, the elevator is placed mesially, then distally and gentle elevation is applied to the crown. The "Thirty-Second Rule" is used, with patience being a virtue. If needed, forceps are used to gently grasp the tooth and rotate the crown buccally. If the crown is rotated palatally there is a risk the apex will perforate the alveolar septal bone, ensuring oral nasal fistula formation. The best force to use is gentle traction following the contour of the root.

Mandibular Canine Teeth - extraction of mandibular canine teeth in felines and small dogs represents the greatest likelihood of extraction misadventures (discussed later). The key to successful extraction is understanding that the mandibular symphysis is cartilage, and that the root structure of the canine teeth can represent 70 percent of the jaw volume. Successful extraction of the lower canines is accomplished by preserving supporting bone lingually and as much as possible labially. Dental radiographs will determine the amount of available bone and the degree of ankylosis present. This is especially important in geriatric felines. Failure to radiograph mandibles is a major reason for extraction nightmares.

The first surgical step in a routine mandibular canine extraction is creating a releasing incision of the alveolar ridge from the distal surface of the canine extending to the labial ventral surface of the first premolar. The next incision starts at the juga of the lateral incisor and extends apically and distally through the labial frenulum to the level of the mental foramen. Next, a molt periosteal elevator is used to create a full thickness flap separating the attached gingiva and oral mucosa from the labial surface of the mandible. The molt is used to also separate the adjacent oral mucosa from the lingual side of the canine tooth to allow placement of a dental bur. When finished, the top one-half of the labial surface of the mandibular canine root, and approximately 2.0 mm of the lingual bone is exposed. A number two round surgical bur is used to remove approximately one third of the alveolar bone on the labial surface (being careful to avoid the mental foramen). Next, the bur is used to remove approximately 1 mm of bone to a depth of 2 mm on the lingual surface. This furrow allows placement of a dental elevator and gives purchase to the working tip.

Extraction forces include labial, mesial, and distal displacement. In addition, forceps can be used to provide rotational forces (the safest force to use on this tooth). The area of greatest retention on the lower canine is the dorsal surface mesial to the first molar. If this bone can be manually removed with elevators or burred with a number two bur the retention forces are greatly

reduced. Especially in small animals with fragile mandibles, the best technique is to surgically remove the dorsal component, then use rotational forces. If prying or gouging forces are used there is great risk for iatrogenic fracture. Difficult extractions are best met with patience and surgical burs. More harm is done with aggressive prying than aggressive burring. Rotational forces are held for a minimum of 30 seconds in each direction. The sequence is repeated for two to three minutes, then a resting period to allow for alveolar hemorrhage which helps displace the tooth. By slowing down the whole process is speeded up and a successful extraction is realized.
Once the tooth is removed, closure is by simple interrupted inverted sutures. Generally there is great apposition of the labial mucosa to the mandible and the lower lip is esthetically repositioned. In giant breed dogs, the alveolus may be filled with Gelfoam or any other hemostatic agent.

Extraction of Feline Teeth
The extraction techniques for the feline oral cavity are essentially the same as the canine species except that all structures are smaller and more brittle. Because cats are plagued with feline odontoclastic resorptive lesions, the veterinary dentist is faced with teeth that fracture easily. The best way to manage this is surgical exposure of the extraction site and circumferential removal of bone from the tooth root to be removed. This technique allows the oral surgeon to tease the tooth root out of the alveolus in one piece. If tooth root separation occurs, a small round bur is used to enlarge the alveolus to gain access to the fragment.
Retention of tooth roots frequently occurs as a result of incomplete tooth extraction or endstage odontoclastic resorption. In either event, dental radiographs of the affected arches are taken to determine the location of the retained roots. Surgical extraction and alveoloplasty of the retention sites is performed.
Magnification is essential to evaluate the completeness of necrotic bone removed. When finished, the alveolus should have clean walls with a blood clot remaining. Retained roots are removed as previously described. Follow-up dental radiographs will confirm the complete removal of retained tooth roots.
The keys to successful extraction of feline teeth are patience, equipment, and technique. As the proverb states, "Haste makes waste". Slow down and do the steps correctly and the operative time will be greatly shortened. In addition, have the correct equipment. This is not an area for Black & Decker drills and hack saw blades. If the practice is not equipped with the proper instrumentation and radiography, refer the cat to a veterinary dentist. The client and animal will be grateful.

Extraction Misadventures
Complications occur if there is insufficient bone left to support normal muscle tone or when other factors are at play (neoplasia, mycosis, metabolic disease, uncooperative animals, or noncompliant owners). Each complication is addressed individually. If the failure results from too little bone present, salvage procedures are directed at maintaining function and health. The other causes of failure should have been anticipated with preoperative blood work, history, physical exam, and interoperative dental radiology. The standard protocol should include histopathologic examination on any abnormal tissue found in the mouth during a dental procedure. When in doubt, BIOPSY. Extraction misadventures result from:

- Failure to visualize tooth (x-ray and surgical exposure)
- Impatience
- Too much horizontal force
- Too much vertical force
- Too much rotational force
- Too much grasping force
- Insufficient bone removal
- Failure to isolate each root

The consequences of a misadventure are: Increased operative time to complete the extraction and further trauma to the animal. If tooth roots are left in the animal, most will abscess and be lost through inflammation. All of these problems can be avoided if the oral surgeon follows each step and does not cut corners.
If a tooth root does fracture, the surgeon should be able to remove it if proper instrumentation is available. To remove a root tip the surgeon radiographs the retained tooth root tip to determine its size and structure. Next, a small round or pear-shaped bur is used to circumferentially cut around the root tip to allow for placement of a root tip elevator. Usually the alveolar wall must be enlarged just enough to make space for the elevator. In most instances this is not a problem, but care must be used in small breed dogs, cats and other animals with significant horizontal bone loss. Over enthusiastic use of the bur when extracting an upper fourth premolar may result in penetration of the infraorbital canal. The oral surgeon makes this mistake once in a career (the reason becomes very obvious as the resulting hemorrhage is quite impressive and difficult to control).

Controversial Techniques

Atomization - this technique has been described as the pulverization of tooth roots with a bur. In cases of endstage ondontoclastic resorption in felines, extraction is better accomplished with root tip picks and fine blade elevators. Merely twirling a round bur in the alveolus gives very little tactile feel of what is tooth root and what is bone. Significant collateral damage plus inadequate root removal are two common outcomes. Normal root structure is best removed using the above described techniques. Burring out normal tooth roots is rarely complete and frequently results in the continuation of the inflammatory process.

If atomization is used, radiographs are mandatory both preoperatively and postoperatively to document complete removal of tooth root. Incomplete tooth root removal is considered malpractice if the veterinarian records the teeth as being extracted.

Crown Amputation Technique - crown amputation is a procedure where tooth roots are intentionally left in the mouth. The only indication for this procedure is for treatment of teeth affected with feline odontoclastic resorptive lesions with no evidence (verify radiographically) of periodontal disease. Improper use of this technique can lead to disastrous consequences to the patient. Therefore, case selection is extremely important. In general, this technique should be reserved for the geriatric animal with noninflammed roots where anesthesia time is critical. In all other cases conventional surgical extraction is the best option.

References

1. DeForge DH, Colmery BH. An Atlas of Veteinary Dental Radiology. Ames: Iowa State University Press, 2000. - Available from amazon.com

2. Mulligan TW, Aller MS, Williams CA. Atlas of Canine and Feline Dental Radiology. In: Veterinary Learning Systems. New Jersey: Trenton, 1998. - Available from amazon.com -