Chapter 21: Extraction

This chapter is near the end of the book as extraction is typically the last resort. I want you to think of other options before leaping to extract.

Tooth extraction, or exodontia, is the most common surgical procedure in most veterinary facilities. Though some seem loath to admit defeat and resort to toothanasia, it is frequently the most rational treatment option. Done properly, extraction of diseased teeth can lead to a dramatic improvement in the health and well-being of the patient. Done poorly, continued suffering is the result. Therefore, every veterinarian, dentist or not, must make themselves proficient at extraction and know when to refer cases beyond their skills.

Before we get into the “How” of extractions, I would like to get on my soapbox regarding the “Who” of extractions.

Who Should be Extracting Teeth?

When I speak to veterinary technician groups, I am usually asked for information on extraction technique, particularly in regard to feline teeth with resorptive lesions. From these enquiries it is apparent that, in many practices, auxiliary staff are responsible not only for the decision to extract, but also for the surgery itself. This troubles me greatly and it seems to trouble many technicians as well.

A cardinal rule of extractions is that “they can be awfully simple or simply awful.” In my experience, exodontia can be a very challenging procedure to perform properly and the opportunities for complications are many. These complications include retained root fragments with persistent infection and pain, jaw fractures, chronic oro-nasal and oro-antral fistulae, delayed healing with chronic alveolitis and changes in occlusion leading to trauma to soft tissues in and around the mouth.

I have repeatedly declined to teach technicians extraction technique, citing the Ontario Veterinarian’s Act, Practice Standards as support for my position. As it turns out, this document leaves the question open. To quote from Section 19;

1) "A member is responsible for the conduct of his or her auxiliaries and for the suitability and quality of the performance of their acts.

(2) "A member is guilty of professional misconduct if an auxiliary of the member does or omits to do anything that, if done or omitted by a member, would constitute professional misconduct.

(3) "A member properly supervises the performance of an auxiliary's task if the member,

> (a) is physically present on the premises when the task is performed, remains available for personal intervention if required and monitors the performance to determine that the task is properly carried out; or
>
> (b) if absent on account of an emergency or otherwise temporarily absent and the performance of the task does not require the member's attendance, has given general instructions for such an occasion and the member ascertains as soon as practicable after the task is performed that it was properly carried out."

Loosely interpreted, this section says that an auxiliary can do any surgical procedure, so long as the veterinarian feels the auxiliary is capable, the veterinarian is available to help and checks that the job was done properly. In theory then, technicians would be allowed to do cruciate ligament repair, bone plating, enterotomies and so on. Now I doubt if any technicians are doing these procedures, because we all recognize that their training and experience do not prepare them for these complicated surgical procedures. In fact, I doubt if many technicians are neutering male dogs or removing cutaneous cysts.

Why then, are technicians so commonly called upon to make oral diagnosis and perform extractions? My guess is that the answer is rooted in tradition.

There was a time when only very loose teeth were extracted and so the decision to extract and the procedure itself offered little challenge. The tooth was just wiggled and if it popped out, the wound was left to heal by second intention. Teeth that were firmly held in place were left to rot further to facilitate extraction at a later date. In those days, a technician may have been able to do the job just fine.

With the advances in veterinary dentistry in the past few years, extractions are no longer as simple as they once were. Clients demand a much higher level of dental care for their pets than ever before. Many want no less for their

pets in the way of medical and dental care than they receive themselves. Many conditions are now seen as solid indications for extraction, even of teeth that are not the slightest bit loose. As well, treatment options other than extraction are now available, even for seriously diseased teeth.

Owners want to see their pets recover rapidly and comfortably. To reduce post-operative pain and increase the chance of rapid, uneventful healing, most extraction procedures also involve alveolar curettage, alveoloplasty and gingival flaps to close the wound and may include the placement of bone grafting materials for enhanced healing of the alveolus.

One result of increased client expectations and advances in veterinary dentistry is that exodontia has become an intricate and delicate procedure involving careful treatment planning, radiography and radiology and hard and soft-tissue surgeries. In short, exodontia is no longer a procedure that can reasonably be delegated to auxiliaries.

In recognition of the above, the Council of The College of Veterinarians of Ontario, in 2001, issued a Policy Statement that "*auxiliaries not diagnose, prognose, prescribe or perform major surgical procedures*." Major surgery includes any procedure that involves bone or entering a body cavity, among other criteria. Extraction involves diagnostic and prognostic evaluation and major surgery, so it is the Policy of the Council of the CVO that auxiliaries not perform extractions. In time, this policy may become law. In many jurisdictions in North America it already is.

Some veterinarians may claim that it is not economically feasible for them to perform extractions. My answer to that is that they need to re-evaluate their fee structure for extraction and make it economically feasible. Just imagine that you are in your dentist's chair for an extraction and the dentists pops in to say "Hi" and then informs you that his/her assistant will be along in a moment to pull your tooth. My guess is that you would be out the door in a flash.

Exodontia should be performed by a licensed veterinarian who is very familiar with dental and paradental anatomy, physiology and pathology and who has accumulated the appropriate tools and skills.

Some veterinarians really detest extractions. Rather that delegating to an auxiliary, they should consider referral to a veterinarian who enjoys dentistry and is properly equipped to do the job well. There are a number of such practitioners and the number is growing. Alternately, those who do not now enjoy dentistry might consider learning more about it and investing in some appropriate equipment. They may find that, once properly prepared, they find dentistry rewarding for their patients and for themselves.

Tips on Extraction Technique

One of the tricks to successful extraction, or any surgical procedure, is knowing what it is you are trying to accomplish. Of course, some teeth are so loose, you need only shake the animal's head and the rotters come flying out. On the other hand, how about those multi-rooted teeth with one rotten root and two others that are in as solid as a rock? How about cats with advanced resorptive lesions? To visualize what you are trying to do, you need to know the anatomy of the roots and those structures around them. Much of this has been covered in Chapter 7 but is reviewed here in a condensed version.

Anatomy Review for Extraction:

Each tooth has a specific number of roots, normally. In the dog, incisors, canines, first premolars and third lower molars all have one root, upper fourth premolars and upper first and second molars have three roots and the remaining teeth have two. In cats, incisors, canines first upper premolars and first upper molars all have one root, the third upper premolar has three and the rest have two. Of course, sometimes nature plays tricks on us and a tooth will have more roots than it is supposed to have. This is why a pre-extraction radiograph is an excellent idea (mandatory, really).

Near the *neck* of the tooth (i.e., the *cemento-enamel junction*), you should find some *gingiva.* This is the band of firm, collagen-rich tissue that acts as the main mechanical barrier to invasion of the periodontal space. The most coronal portion of the gingiva is not attached to the tooth and so is called *free gingiva*. Apical to this is the *attached gingiva*, which has two regions. The more coronal portion of the attached gingiva is fairly loosely attached to the cementum of the root and is called *junctional epithelium*. Apical to this is a band of very firmly attached gingiva,

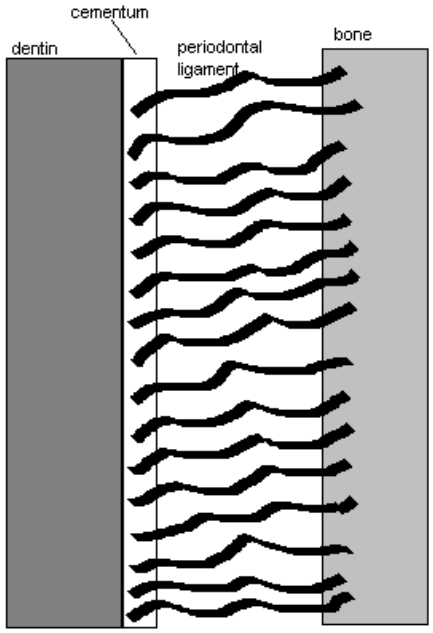

Figure #21.1. A very simplified diagram of the periodontal ligament with Sharpey's fibers embedded in cementum and alveolar bone.

which attaches to cementum and the bone of the jaw.

In health, the tooth roots are suspended within the bony confines of the *alveolus* by the *periodontal ligament.* The portion of the ligament fibers embedded in the cementum of the root and in the alveolar bone are termed *Sharpey's fibers*. The remaining fibers are known simply as periodontal ligament fibers. The fibers follow a gently waving course from cementum to alveolar bone. The slack in the fibers allows for some tooth movement without damage to the ligament.

Figure #21.2. An exaggerated depiction of Hypercementosis. The increased thickness of cementum causes the root apex to be wider than the alveolus above it, thus locking the root in the socket.

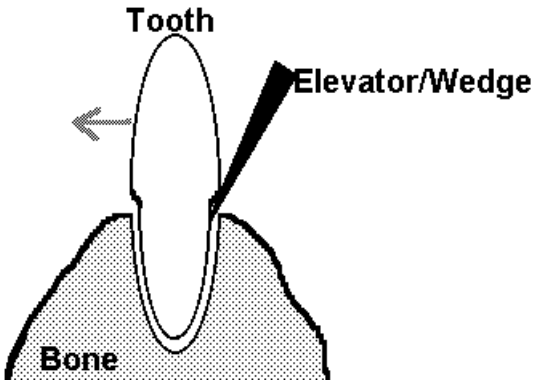

Figure #21.3. As the thin edge of the elevator is advanced into the alveolus, it forces the tooth to the opposite side of the alveolus thus stretching the periodontal ligament fibers on one side and compressing them on the other. By doing this all around the tooth, the ligament is disrupted and the tooth becomes loose.

The periodontal ligament acts as a shock absorber so that when the tooth strikes something hard, it can move a little instead of breaking easily. In a young animal, the periodontal space is comparatively wide but it becomes narrower with age. If a tooth suffers from chronic trauma (chewing natural bones, for example) the ligament may calcify leading to *ankylosis* of root to alveolus. This not only makes the tooth much more likely to fracture, it also makes it immensely harder to extract.

Another sequel to chronic irritation of a tooth root is a condition known as *hypercementosis*. This is the development of excessive amounts of secondary cementum on the root surface, and it usually occurs most dramatically around the apex. This apical bulge can give the apex a larger diameter than the alveolus coronal to it, effectively anchoring the root tip in the alveolus the same way the balloon on a gastrostomy tube holds it in place.

When we are trying to extract a tooth that has not undergone ligament ankylosis, the object is to separate the ligamentous attachment between tooth and bone by applying various forces to the tooth. Once the tooth is loose enough, it should pull out of the alveolus relatively easily. Trying to pull a tooth that has not been loosened will result in fractured roots and excessive trauma.

The rule some of you may remember from school is ELEVATE, ELEVATE, ELEVATE! The purpose of elevation is to stretch, and fatigue the periodontal ligament and rupture its

fibers. The periodontal ligament can tolerate dramatic forces of short duration, but even minimal force over a long time damages the ligament. Therefore, to elevate a tooth, a moderate force applied for several seconds will be far more effective that a dramatic force applied for one or two seconds. In elevating, we employ the principles of the lever: three different types of levers, in fact.

The most used lever in exodontia is the wedge. Here we insert the thin edge of the wedge/elevator into the space between the tooth root and the alveolar bone. By pushing the elevator apically (towards the root tip), the root is pushed laterally away from one wall of the alveolus until it bangs up against the opposite wall. If this force is maintained for a count of ten, blood will fill the increased space and exert hydrostatic force to enhance the fatiguing effect on the ligament. By applying this wedge force at many places circumferentially around the tooth, a large percentage of the ligamentous attachment is significantly weakened.

Another way elevators are used is as simple class-I levers. It is often possible to engage the end of an elevator under the *cervical bulge* above the cemento-enamel junction. Then, using the alveolar crestal bone as a fulcrum and the elevator handle as the lever, you can apply a lifting or *extruding* force on the tooth to stretch and fatigue the ligament fibers around the apex.

The third type of lever action from an elevator is the wheel and axle. Here the lateral edge of the elevator engages the tooth at the CEJ and rotation of the handle (axle) causes the edge of the elevator (wheel) to apply an extruding force on the tooth. This principle is used extensively in human dentistry where they use elevators specifically designed for this.

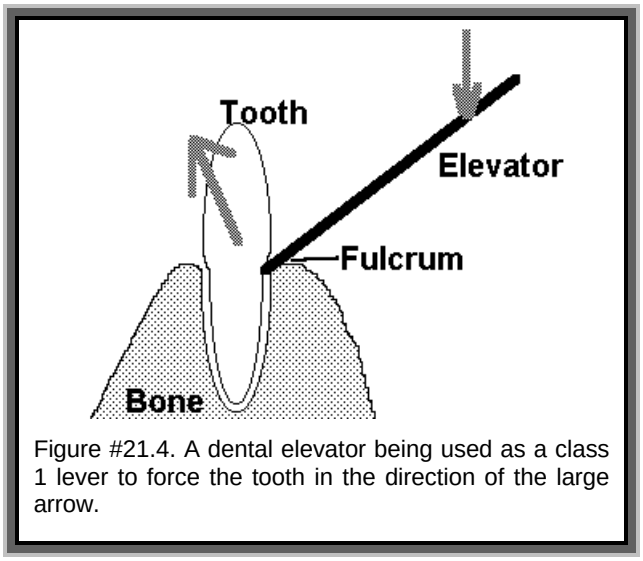

Figure #21.4. A dental elevator being used as a class 1 lever to force the tooth in the direction of the large arrow.

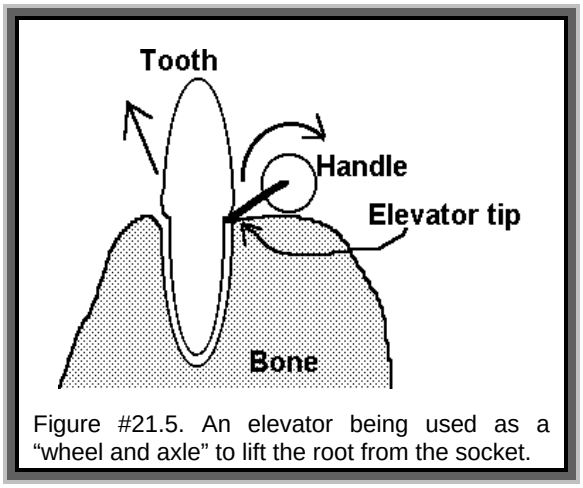

Figure #21.5. An elevator being used as a "wheel and axle" to lift the root from the socket.

Equipment For Extractions:

When it comes to dental elevators, everyone seems to have their favorite style and design and since the catalogues contain a wide selection, you need not limit yourself to just a few. Quite the contrary, you should have lots of elevators. Dogs and cats come in many shapes and sizes and so do their teeth. Personally, I have about twenty elevators and I use them all. You should have large elevators, small elevators, medium elevators, and very fine root tip picks. There are special curved Fahrenkrug elevators for canine teeth and Wiggs winged elevators for long conical roots. The list goes on.

I sometimes find that endodontic files are useful in extractions, particularly Hedstrom files, which have very deep and sharp threads. If a root tip becomes separated from the rest of the tooth, deep in a narrow socket, it can be very tricky to grasp and retrieve. If there is a visible root canal, you can screw a Hedstrom file into the canal and grab the root from the inside. I have used this trick to save the day on several occasions.

Forceps also come in a variety of sizes, but here I limit myself much more. The forceps are really not supposed to be placed on the tooth until it is quite loose and so they need not be terribly strong. I have a few styles and sizes but use pediatric/small breed forceps almost exclusively. The shorter handles are less effective levers and so the chance of generating excessive force and crushing the crown is reduced. I like ones with spring-loaded handles.

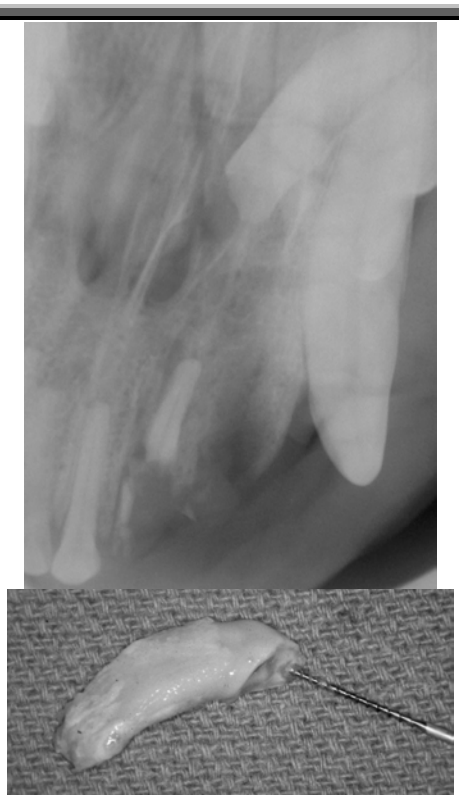

Figure #21.6. In the radiograph, you can see the lateral incisor sitting within the nasal passage beside the root of the canine tooth. Fortunately, the crown of this tooth was broken, exposing the pulp chamber. A Hedstrom endodontic file was screwed into the pulp chamber to grab the tooth from the inside, facilitating its easy retrieval from the nasal passage.

Root tip forceps of some type are a good investment. They are very fine and delicate and so can be useful, not only for retrieving wayward root tips, but also for working on deciduous teeth and feline incisors.

Many extractions require a flap procedure of some type, either to get exposure to the tooth or to aid in closing the wound. Therefore, a fine, delicate periosteal elevator is a must. Again, having a few sizes is a good idea.

Many of the teeth you will be called upon to extract have more than one root and these are almost always easier to extract if they are first sectioned into single root segments. This is most efficiently and safely done with carbide or diamond dental burs in a high-speed dental hand piece. Taper fissure burs such as the 701L do the job nicely. Low speed hand pieces can also be used with these burs, but they are considerably slower.

Round burs in a high-speed hand piece are useful for removal of alveolar bone either to expose a root for extraction or to smooth the alveolar bone prior to closing the wound. Low-speed hand pieces can also be used, but an assistant must lavage the area with sterile saline to avoid thermal necrosis of tissues. Rongeurs, bone files and chisels can all be used in the absence of power equipment.

Diamond coated cutting disks, as often sold to veterinarians with low-speed hand pieces, are to be avoided. Ask a human dentist if you doubt me on this. These disks are intended for cutting plaster models in the dental laboratory. They were never intended for use in a patient's mouth because they are very dangerous. They can cut through the tooth you want to extract very quickly, but they can also cut through opposing teeth, lips, tongues, gums and your fingers. Do not use them and do not let any fast-talking salesperson sell you any.

Many teeth are extracted due to chronic endodontic infection. Your pre-operative radiograph will often indicate areas of diseased tissue around the root tips. After extracting such a tooth, I like to curette the alveolus to remove any inflamed soft tissue such as apical granulomas. Spoon curettes are the tool for this job.

Finally, after getting the tooth out and cleaning up the area, you will want to close the wound. You will need fine, absorbable suture material (4-0 or 5-0) and delicate needle drivers to handle it, as well as rat tooth Adson forceps.

Divided They Fall

Many of the teeth we are called upon to extract have more than one root. Often this is not a problem because the teeth are so loose you could blow them out with a hair dryer. There are times, however, when we must extract a multirooted tooth that is still firmly embedded in the bone. A good example would be a fourth upper premolar with a slab fracture and pulp exposure in a dog whose owners decline endodontic treatment to save the tooth.

Teeth with more than one root usually have their roots diverging from crown to apex. This acts to anchor the tooth very firmly in the bone. To extract the tooth in one-piece means excessive

trauma to the alveolar bone, root tip fracture or both. This can lengthen the time it takes to remove the tooth and for the extraction site to heal while causing excessive post-operative pain.

Extraction of multirooted teeth can be done much faster, with far less trauma if the tooth is divided into single-root sections prior to elevation.

Sectioning allows the operator to remove one root at a time. Therefore, the surface area of attachment you are working against at any one time is reduced substantially. You can also now place an elevator between the sections of crown and lever one section against another. Single root sections can be twisted around their long axis which will add to the number of directions and types of force you can apply to the periodontal ligament to fatigue and weaken it.

Now, how do you go about sectioning a tooth? The fastest and safest way is with a carbide or diamond bur in a high-speed dental hand piece. The next best is with the same type of bur in a low-speed hand piece. Using a taper fissure bur such as a 700 or 701 allows for very precise control over the cut so the risk of iatrogenic trauma is reduced. The cutting portion of a 701 bur is about as big as the exclamation point at the end of this sentence! These burs are fine enough that I routinely use them to section off the palatal root of the fourth upper premolar in cats.

After severing the gingival attachment to the tooth circumferentially with a number-11 scalpel blade, retract the gingiva to expose the furcation. Starting at the furcation and cutting towards the crown, cut the tooth into sections, as shown in Figure #21.7.

Another method of sectioning that is often touted is the use of a diamond encrusted cutting disk used in a low speed hand piece. These disks are about the diameter of a quarter but much thinner in cross section. The edges have diamond grit embedded and when these disks hit a tooth, they zip through it like nothing else. The trouble is, they also zip through fingers, tongues, lips, opposing teeth and anything else that gets in the way. They are just too big and cumbersome to be used safely in most situations. Diamond disks are dangerous and should be avoided.

Extraction Technique

The three classic rules of extraction are 1) elevate, 2) elevate and 3) elevate. This rather simplistic approach has some merit, but there are some other rules I would encourage you to follow.

1. Always take a pre-operative radiograph. You need to know what you are getting into and you should be documenting the situation if you ever have to explain your reasons for extracting.
2. Section multi-rooted teeth into single-rooted elements. This one simple action will make an incredible difference to you and your patient.
3. Keep your elevators sharp. In many cases, you will be trying to insinuate the tip of your elevator into the periodontal ligament space to act as a wedge. This space is usually less than half a millimeter wide and so a dull instrument will not fit in. Rather it will traumatize the alveolar crestal bone but not aid in loosening the tooth.
4. Handle the soft tissues as carefully as possible. You will want to suture the wound closed and you need this tissue for that. Also, carefully handled tissue will heal faster and be more comfortable for the patient.
5. Suture the extraction sites closed. Many will leave them open giving the excuse that there may be a need for drainage. If you remove the source of the infection and debride the socket well there is likely no need for drainage. Open extraction sites do not drain. They get plugged

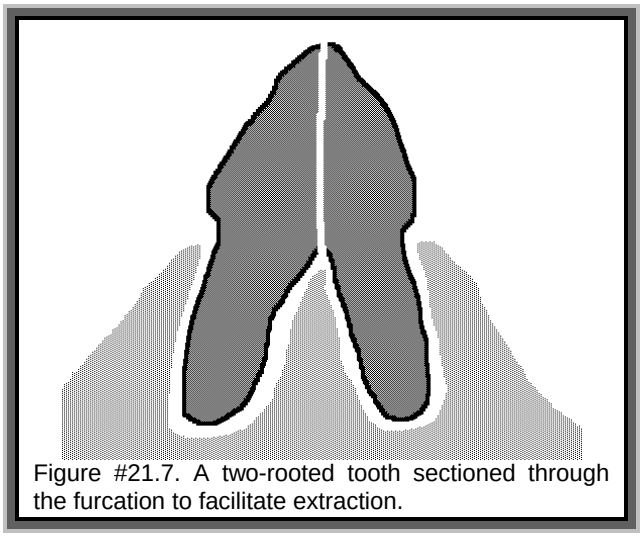

Figure #21.7. A two-rooted tooth sectioned through the furcation to facilitate extraction.

with food, hair, bacteria and all sorts of crud. This will not only delay healing, but will also be much more painful for the patient.

6. When elevating flaps for extractions, try to avoid vertical releasing incision that cut across the blood vessels. Try to use envelope flaps that are more conservative of the vasculature. If a releasing incision is needed, try to place it at the mesial aspect of the flap, again to preserve the blood supply as much as possible.
7. Keep your fingertip very close to the end of your elevator tip so that if you slip, you do not run the elevator right through your patient's eyeball or brain. (This has actually been reported in the Journal of Veterinary Dentistry).
8. Know your dental and craniofacial anatomy!!!
9. Exercise patience. Going too fast can really slow you down.
10. Use intra-oral local anesthesia as pre-emptive pain management.

Extraction Site Closure

I routinely suture extraction sites. The only time I do not bother is if the wound has a smaller diameter than the needle I would use to place the material (like a single cat incisor). The reason – closed wounds heal faster and are more comfortable for the patient.

An extraction site is an open wound, with alveolar bone exposed. If such a wound is left open to granulate, food and other debris will find their way into the wound. The result is delayed healing at best and an infected open wound with osteomyelitis at worst. Even if the wound does heal, it is more likely to be a source of pain for the patient than a properly closed wound.

Some will suggest that they leave extraction sites open to drain. That would be fine if you could be certain that the patient would flush the wound with an antiseptic wash and gargle with salt water for one minute twice daily to remove all food and debris from the defect. Since this is not going to happen, the wound should be closed.

Rarely does an extraction site require drainage. In cases where there is significant infection deep into the alveolus, I will curette the alveolus to remove any reactive soft-tissue and surface contamination prior to closing. I will then send the animal home with antibiotics.

A closed wound is far more comfortable for the patient, allowing for a more rapid improvement post-operatively. It also heals much faster, again speeding recovery. Yes, it does take longer to suture extraction sites than not suturing, but that should hardly be an issue.

Guidelines for Extraction Site Closure:

The first step in closing an extraction site is deciding that you are going to do it. If you decide from the outset that you are going to close the wound, you can plan your incisions and flaps in such a way as to make closure easier. In order to plan ahead, you must keep a few points in mind. These are the basic, underlying principles that should be adhered to in all cases to improve the chances of success.

- There must be no tension on the suture line. If there is tension, you can bet the wound will breakdown.
- Try to arrange things so that the suture line is supported by connective tissue instead of being placed over a void. This is not always possible, but it is always desirable.
- After tying each suture, pull the knot over to one side or the other so that the knot is not directly over the wound.

Figure #21.8. This picture indicates that the blood flow into the maxillary oral mucosa and gingiva comes from dorsal and distal as the infra-orbital artery emerges from the foramen dorsal and mesial to the fourth upper premolar. Keep this in mind.

- Gingiva holds a suture better than oral mucosa. On the other hand, severely inflamed gingiva is very friable and suture material may pull through like piano wire through wet toilet paper. Therefore, wide bites may be necessary to find tissue capable of holding the suture.
- Handle the tissues as carefully as possible to maintain blood supply. Rat-toothed forceps are far better than ones that hold by crushing.

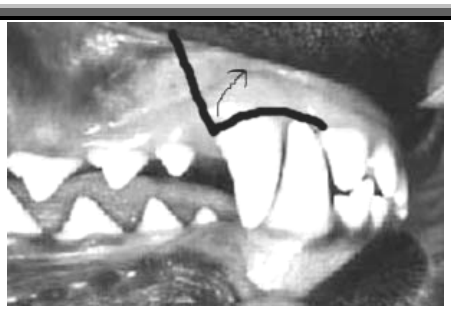

Figure #21.9. This is a badly design flap for the extraction of the right maxillary canine tooth. Unfortunately, this is the flap that is depicted in many references. The problem is that the apex of the flap, in fact the entire distal edge has severely compromised blood supply.

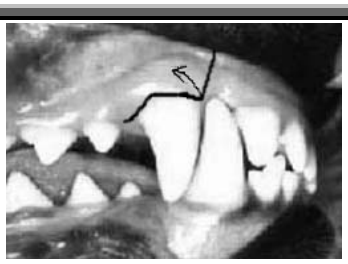

Figure #21.10 This is a better flap for extraction of this canine. The tissue mesial to the incision can be left lying on the bone so that its sub-periosteal blood supply remains intact. The raised portion of the flap should still have vessels reaching into the corner. The result will be better vitality of the flap and so better healing.

- Elevate your gingival flaps prior to sectioning teeth or contouring bone. Get the soft tissue out of the way so you do not damage it during the other parts of the procedure.
- Use a sharp periosteal elevator to raise your flaps. Several types are available. My preference is the Cislak EX7 Feline Periosteal elevator. I find it fine enough to raise flaps in cats but substantial enough for much larger flaps in dogs. It is the only style I use – I have several of them.
- Try to avoid vertical releasing incisions whenever possible. Vertical incisions cut across blood vessels and compromise the vascularity of the flap. Instead, try to work with envelope flaps. If you must make a vertical releasing incision, try to place it at the mesial (rostral) edge of the flap instead of at the distal edge.

Mucoperiosteal Flaps

In many cases, it is not possible to simply appose the buccal and palatal/lingual edges of the wound. It is necessary to elevate flaps on both sides and to advance the flaps across the defect to meet without tension. Since gingiva has very little give, it is often necessary to elevate the flap beyond the mucogingival junction. The oral mucosa has a far greater capacity to be moved about and manipulated.

The design of your flap will have a great impact on the prognosis for healing. Very simply, oral flaps should be designed with the same principles as cutaneous flaps. These include having a broad base, handling the tissue carefully and undermining sufficiently to allow tension-free closure.

In developing any oral flaps, it is important to understand the blood flow to the region, as it is imperative that adequate blood flow in the flap be maintained.

Without getting all anatomical on you, the oral mucosa and gingiva receives its blood from vessels within the soft tissue as well as from vessel that pop up through the bone here and there. An incision that severs the vessels within the soft tissue may not compromise the tissue significantly, if it is left attached to the periosteum and bone so that the sub-periosteal vessels are intact. However, if a flap is raised off the bone, the sub-periosteal vessels are severed and the margin of the flap has lost most of its blood supply.

Arterial blood flow to the oral soft tissues flows from the heart toward the nose: an obvious statement but one that seems to be ignored frequently.

Many sources suggest elevating a full thickness flap over the root of the maxillary canine tooth to allow for some buccal bone removal to facilitate extraction. Most of the diagrams I have seen depicting this show a vertical releasing incision distal to the canine tooth and then the flap is reflected mesially. I feel this is wrong. It severs the vessels within the soft tissue supplying the distal edge of the flap and then elevates that edge off of the bone, severing the sub-periosteal vessels. The result is a severely compromised flap and there is no reason to do it this way.

Figure #21.11. The black line (at right) represents the proper placement for a vertical releasing incision at the line angle (corner) of the tooth. The gray line to the left is placed in the diastema between the teeth, which is wrong and the centre line is placed in the middle of the buccal face, which is also wrong.

Instead of making the releasing incision distal to the tooth, it should be made mesial to the tooth. Now it can be elevated from the sub-periosteal blood supply because it still has vessels intact within the flap right to the edge. The tissue mesial to the flap is not elevated so it still has its sub-periosteal supply intact.

In doing a vertical releasing incision, there is one more rule to consider. The placement of the incision relative to the tooth and gingival sulcus is important. To follow this next bit, I have to explain some anatomical terms.

Each tooth is considered to have four faces. The face against the lips or lining of the cheek is the buccal, facial or labial face (I just use buccal).

Figure #21.12. An envelop flap from the lateral incisor to the fourth premolar. There are no releasing incisions.

The face against the tongue (for mandibular teeth) is the lingual face. On the maxilla, the face adjacent to the palate is the palatal face. The face of the tooth closest to the tooth in front (or closes to the mid-line) is the mesial face and the face closest to the tooth behind is the distal face.

The place where two faces meet (i.e. the corner of the tooth) is known as the *line angle*. Where the buccal face and the mesial face come together is known as the mesiobuccal line angle.

So where should you start your releasing incisions, relative to the tooth? At a line angle.

The Envelope Flap:

An envelope flap involves no vertical releasing incisions, rather, its incision is horizontal. The incision, generally on the buccal side of the teeth, severs the gingival attachment to the tooth (teeth) and cuts through the gingiva in the interdental spaces. The flap is then elevated from the bone and reflected dorsally (for the maxilla) similar to retracting a straight cutaneous incision.

An envelope flap is most conservative of the vasculature and can be extended mesially and distally intra-operatively if more exposure is required. A vertical releasing incision cannot be moved mesially or distally once you make your cut. Therefore, with an envelope flap, you can start with a conservative (small) flap and extend it as needed to allow adequate exposure and tension-free closure.

Figure #21.12 shows a rather large envelope flap extending from the distobuccal line angle of tooth 107 to the mesiobuccal line angle of tooth 103. The flap was raised to allow removal of some teeth and then a rhinotomy to remove a compound odontoma that was situated in the right nasal cavity. The incision is parallel to the blood supply and within gingiva for its entire length. Since the elevation of the flap extends beyond the mucogingival junction to involve the maxillary oral mucosa, it was easily advanced to meet the palatal side of the incision without tension.

If the defect to be closed is large (as in after removing a lot of tissue to excise an oral mass), it may still be difficult to advance an envelop flap far enough to get tension-free closure. To get more advancement from the flap, you can elevate further and/or incise the periosteum at the base of the flap.

The downside of the envelope flap is that it involves elevating the gingiva from teeth either side of the surgical site – teeth that are going to be left in the mouth. This compromises the periodontal status of these teeth. If the flap is elevated and replaced carefully, the gingiva should reattach to the teeth left in and the normal periodontal relationships should be re-established. However, it is wise to assume that elevating and replacing a flap in this manner may lead to the loss of about 1 millimeter of alveolar crestal bone. For most teeth, the loss of one millimeter of bone is of little significance and so this is a price I am willing to pay in order to improve the prognosis for healing of my flap.

Complications of Extraction

There are several things that can go wrong during extractions. Being aware of these potential problems can help you avoid them.

Retained Roots:

Probably the most common complication I am called on to deal with is retained root tips. Often the referring veterinarian is unaware that they have left root remnants in place because they did not take any radiographs!!! If a tooth needs to come out, chances are then entire tooth needs to come out, not just most of it.

Damage to Other Structures:

Some roots are very close to important anatomy. The palatal root of the fourth upper premolar is just a thin layer of bone away from the nasal antrum on one side and the infra-orbital canal on the other. The maxillary molar teeth lie ventral to the orbit. The mandibular premolar and molar teeth are often dangerously close to the mandibular canal. Know your anatomy and take pre-operative radiographs to remind yourself of where these structures are. Failure to do this increases the risk of causing serious trauma.

Figure #21.13. This dog had a persistent infra-orbital swelling despite “extraction” of the fractured upper fourth premolar. The problem is immediately apparent on this radiograph. A large portion of the infected distal root was left behind to act as an ongoing source of trouble. The only way to resolve the problem is to remove this retained root.

It is quite possible to fracture a mandible during extraction. It is most common in small dogs with advanced periodontal bone loss. A pre-operative radiograph lets you know how much bone you have to work with and where the weak spots are that you need to avoid.

The layer of bone between the canine tooth root and the nasal passage is very thin and careless technique can result in iatrogenic oronasal fistula.

When extracting deciduous teeth, it is very possible to cause damage to the developing permanent teeth as seen in Figure # 20.13 and #20.18.

When closing an extraction site, it is important that the flaps be under no tension at all. If there is tension at the suture line, the wound will break down, thus delaying healing and increasing discomfort for the patient.

Dry Socket:

Alveoloalgia, alveolitis sicca dolorosa, avascular socket, localized osteitis, fibrinolytic alveolitis, localized acute alveolar osteomyelitis; it seems the less we know about a condition, the more names we give to it.

For the sake of my typing fingers, I will be referring to this condition as dry socket. It is a post-operative complication of extraction and is acutely painful. Though many have searched for the cause, no definitive etiology has been found, indicating that we are dealing with a multi-factorial problem.

The incidence in humans is between 1% and 3% of all extractions and up to 30% of mandibular third molar extractions. I know of no numbers relevant to veterinary dentistry, but I would assume that the vast majority of cases go undiagnosed as the problem tends to occur two to four days post-operatively, and may not be reported or recognized.

Normal post-extraction healing depends on adequate blood to the alveolus and an organized clot to allow for and support proliferation of fibroblasts and epithelialization. In dry socket,

there is a failure of the clot to form properly or it becomes dislodged prematurely. The result is a socket containing necrotic debris and denuded bone.

Several systemic factors have been implicated as *predisposing* to dry socket via their effect on healing in general. These would include, cardiavascular disease, diabetes, liver disease, anemia and blood dyscrasias, vitamin and nutritional deficiencies. Many humans with dry socket, however, are free of these systemic diseases.

Local factors seem to have a greater influence on the development of dry socket. Among these are, insufficient blood supply to the alveolus, pre and postoperative infections, surgical trauma, excessive vasoconstriction from chemical hemostatic agents and excessive irrigation of the alveolus.

If the blood supply to an alveolus is deficient for some reason, there may be insufficient bleeding to develop a good clot. Based on the research, this alone does not seem enough to cause dry socket.

Studies of the relationship between dry socket and peri-apical (root tip) infections have been inconclusive. However, there is a much higher incidence of dry socket when the extracted tooth has been involved in uncontrolled pericoronal (around the crown) infection. Again, these infections may not be the sole causative factor, but should be considered as predisposing.

Post-operative infection also seems to be a factor but no direct relationship between gross post-operative infection and dry socket has been demonstrated. One way in which bacteria may lead to dry socket is by chemical disruption of the clot. Certain strains of hemolytic *streptococci* may cause premature clot lysis and some strains of *streptococci viridans* can inhibit clot formation. Therefore, contamination of the extraction site, even without evidence of gross infection, may contribute to dry socket.

Of all the proposed causes of dry socket, the most important seems to be surgical trauma. H. Birn has suggested that surgical trauma can lead to the release of various tissue activators that act on plasminogen to convert it to plasmin. This leads to clot lysis and the formation of kinins, which cause intense pain.

Retrospective studies suggest that between 60% and 90% of dry sockets occur following surgical extraction (extractions in which soft tissue, bone and tooth need to be cut to allow removal of the tooth roots). As well as the theory on plasminogen conversion, surgical extractions allow greater access to alveolar bone for the oral bacteria such as the aforementioned streptococci.

Post-extraction irrigation of the alveolus is important. Often the alveolus is lined with necrotic and infected bone and soft tissue. To leave this behind will delay healing significantly and may lead to a dry socket, therefore, it is important to curette and irrigate. However, excessive irrigation may predispose to dry socket. If a clot is flushed away after the alveolar capillaries have clotted, a new clot may not form to fill the alveolus.

Overall, it seems that dry socket is caused by a number of factors working together. These include systemic health, status of tooth being extracted and operative technique.

Prevention

The way to prevent dry socket is to deal with and avoid the predisposing factors, namely, antibiotic control of pericoronal infection and good surgical technique. The latter would include gentle tissue handling, appropriate irrigation and curettage and decreased surgical time. Once the alveolus has been debrided and before suturing the wound closed, it is good to ensure that the alveolus is filling with blood.

Some oral surgeons like to pack extraction sites with absorbable or biocompatible dressings to act as a scaffold to support and stabilize the blood clot. Others feel the best thing in an extraction site is a healthy blood clot with no foreign bodies introduced. If a foreign substance is placed in an infected alveolus, it can become a nidus for the bacteria and lead to persistent infection. Therefore, the dressings are only to be used in very clean extraction sites if at all.

Whether a dressing is placed or not, the surgical site should be sutured closed. This will help retain and protect the blood clot and prevent contamination of the alveolus with food and bacteria.

Treatment

Even with an increased awareness of the potential for dry socket, we may still diagnose few cases. As it tends to occur two to four days post operatively, the animals are at home when the pain hits. Animals do not often display their dental pain overtly and many owners will miss the signs. Fortunately, dry socket is self-limiting in many cases, as the body will eventually epithelialize the socket. However, during this time, the animal will experience acute pain in the region of the extraction and may be resentful of having his/her head handled.

If a patient is presented with head pain a few days post-operatively, a careful oral examination may reveal a socket with denuded bone or an area covered with a gray to yellow mass of necrotic debris. This is dry socket.

Treatment is aimed at re-establishing an environment conducive to healing. In humans, the socket is flushed with normal saline and lightly packed with an obtudent dressing, of some type, which should be changed daily. Analgesics are given PRN during this treatment. This treatment plan may not adapt well to veterinary practice.

The following is based on my understanding of the condition and does not come from any published reference.

I would anesthetize the patient, debride and irrigate the alveolus to ensure there is no necrotic or infected tissue left in the socket. A radiograph would be very helpful to rule-out retained root fragments and bony sequestra. Next, I would curette the lining of the socket to establish bleeding. Finally, I would suture the gingiva over the alveolus with an absorbable material. It may be necessary to perform a flap procedure to allow closure without tension. The animal would be sent home on a course of antibiotics and analgesics and reassessed by phone in 24 hours and in the office in seven days or sooner.

As with all post-operative complications, prevention is preferable to treatment. This may mean upgrading your equipment and skills in order to improve your technique. Your patients should expect nothing less.