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Feline Dentistry Mini Series

Session Three: Feline Extractions

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Feline Extraction – a guide to approach and technique

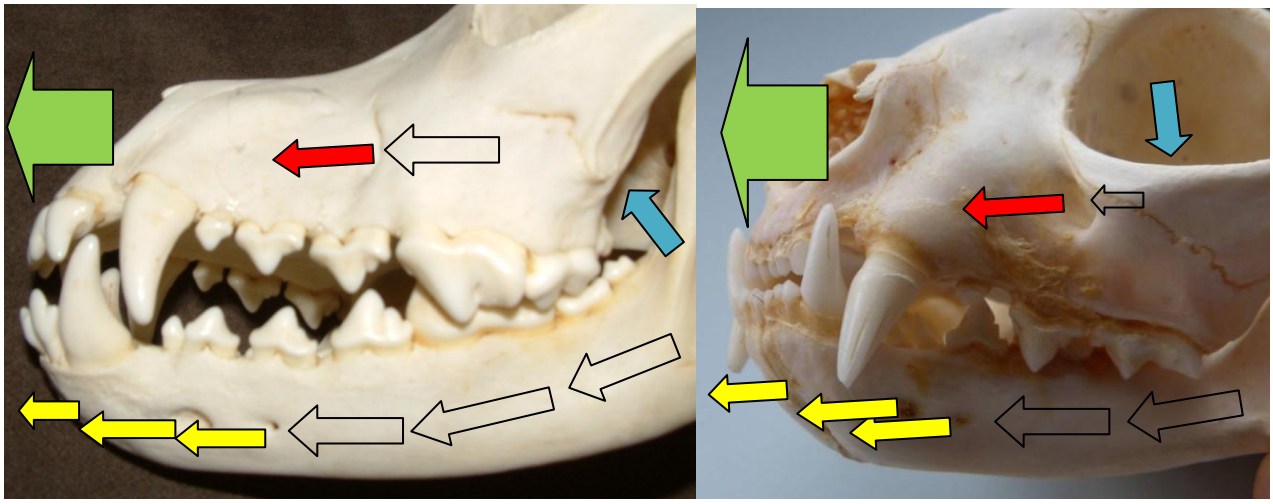
Extractions are a common surgical procedure; indeed the ability to perform basic extractions is generally classed as a day one competency. Based on prevalence, approximately 30% of each daily operating list may be anticipated to be dentistry related, with extraction being a frequent necessity or treatment option. Various extraction techniques exist and the operator should be familiar with these, in addition to the indications for extraction, in order to appropriately advise clients and treat patients. It should also be remembered that extractions have the potential to cause a high degree of pain and collateral damage; in humans for example anticipated pain from surgical extraction is classified as severe and amongst the most painful of surgical procedures.

Extraction techniques are broadly divided into:

Closed (‘simple’ / ‘intra-alveolar’) - techniques are used to displace the tooth within the alveolus

Surgical (‘open’ /’trans-alveolar’) - this involves formation of a soft tissue flap to access the underlying alveolar (socket) bone, followed by removal of an amount of alveolar bone in order to better access tooth root and thereby facilitate extraction.

Essential Anatomy
Prior to surgery and during planning revise and identify the salient anatomy. Structures adjacent to teeth such as the nasal cavity, neurovascular bundles and the eye are at risk of serious iatrogenic damage.



Neurovascular bundles leaving their foramina (infra-orbital = red arrow, mental = yellow arrows) having traversed their bone canals (outline arrows) in the dog (Fig1) and cat (Fig2, right). The vertical dimension of the nasal cavity height is indicated by green arrows. Consider the proximity of roots to these structures. A venous plexus, arteries and multiple cranial nerve branches reside within the space caudal to the hard palate and ventral to the globe and zygoma (blue arrow).

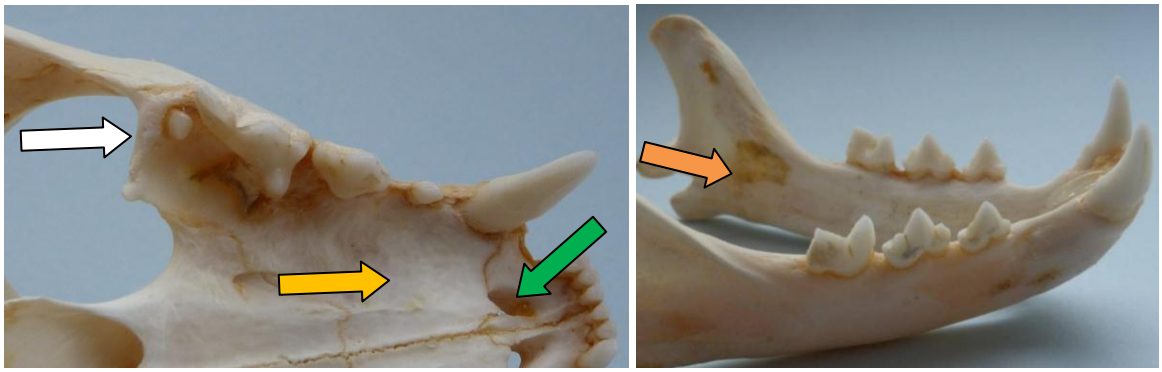


Fig 3&4: Feline; hard palate caudal limit (white arrow), palatine neurovascular bundle exiting the palatal foramen (orange arrow), incisive foramen (green arrow) and inferior alveolar/ ‘mandibular’ foramen (brown arrow).

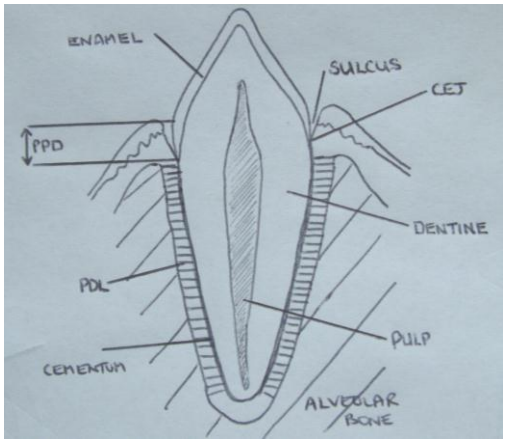


Fig5: tooth and periodontal tissues.
Key CEJ = cemento-enamel junction
PDL = periodontal ligament fibres
PPD = periodontal probing depth

Case Assessment
It is important to fully and accurately assess the mouth and diagnose common cases where extraction may be required. The mouth should be fully charted. A pre-operative, diagnostic radiograph is required to appropriately plan treatment.

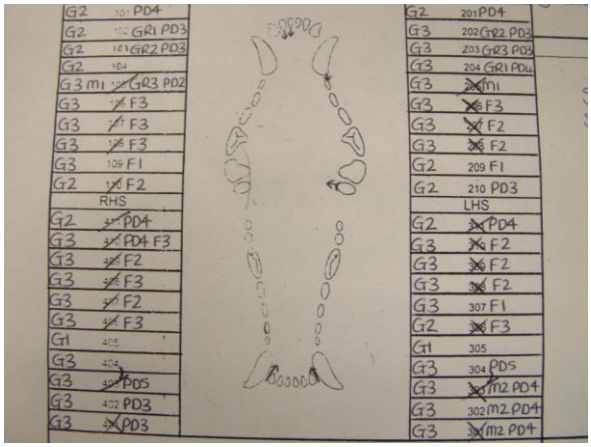


Fig 6: Dental chart

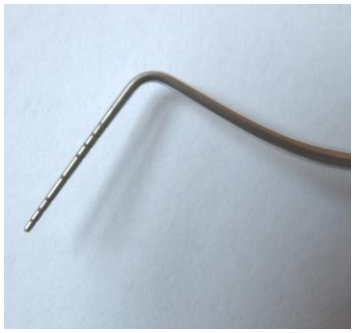


Fig 7: periodontal probe

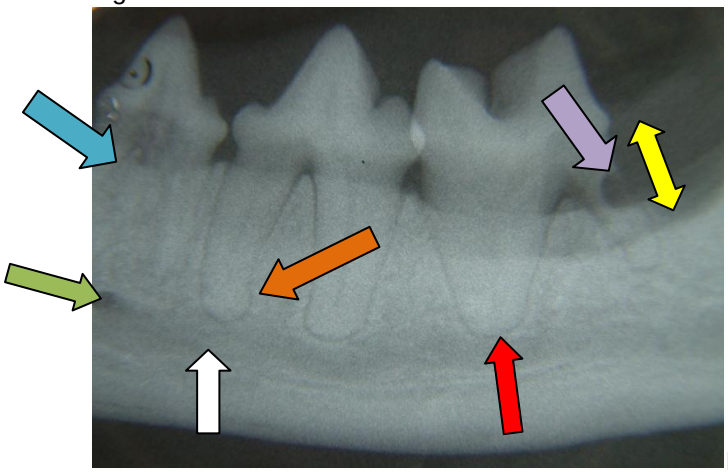


Fig 8: Pre-operative radiograph in a cat with no lesions visible grossly. It is essential for diagnosis, allows treatment planning and aids complication avoidance.

Anatomy to avoid - white arrow=mandibular canal, green arrow=mental foramen
Normal anatomy to consider - brown arrow=curved/ 'globular' root tip, red arrow=proximity of root apex to mandibular canal and neurovascular bundle

Pathology – blue arrow=root resorption (Type 2; 'replacement resorption' & 'ghosting'), purple arrow=resoprtive lesion (Type 1), yellow arrow=horizontal bone loss indicating advanced periodontitis.

Indications for Extraction
Indications for extraction include:
Trauma – fracture and wear causing pulp exposure or near exposure
Abscess & infection
Caries ('dental decay')
Periodontitis
Stomatitis
Resorptive lesions
It is also essential to recognise both indications for extraction and alternative treatments available which may be appropriate or preferable. Client, patient and local factors which incorporate clinical, practical and financial considerations influence these options. Education of ones self in order to educate clients and enable them to make an informed decision and consent is critical. Example alternative treatments may include:
Maxillofacial surgery
Medical treatment
Endodontics e.g. root canal therapy
Orthodontics e.g. tooth movement, reshaping teeth
Restoration e.g. fillings for caries-affected teeth
Periodontal surgery

A pre-operative, diagnostic radiograph is required to appropriately plan treatment.

Surgical Preparation
The field for surgery should be made clean, as with surgery elsewhere on the body. Gross build-up is removed using a scaler (also to allow visualisation and examination via probing) and topical antimicrobial chlorhexidine gluconate (0.12-0.20%) applied to all soft and hard tissue surfaces. Debris must not be allowed to migrate into surgical sites or into the trachea. Prophy paste, if used to polish teeth, should be rinsed away to prevent it contaminating extraction sites and causing healing delay. Some surgeons advocate use of a throat pack (sponge or large swab) to protect the trachea from solids, however this offers very limited protection from fluids and must be tied to the ET tube to ensure it is to not forgotten on extubation. If used it should be frequently squeezed to reduce allow repeated absorption. Ensuring a well-fitting ET tube and downward tip of the nose relative to the rest of the body assists protection of the airway from fluids.
While antibiotics are rarely indicated, it is essential to provide adequate analgesia. A multi-modal, pre-emptive approach to pain relief is required. Analgesics are often incorporated into pre-medicant protocols and may include opiates and NSAIDs. Local analgesic techniques are highly effective and should be used once the patient is anaesthetised and diagnosis obtained.

Surgical Equipment
It is essential that extraction is recognised as a surgical procedure and equipment maintained as such. Equipment should be used only for the specific use for which it was intended. The blades of instruments must be kept sharp – a blunt instrument is dangerous as the operator is tempted to use force, often leading to slippage. Damage to adjacent anatomy such as neurovascular bundles or the retrobulbar space of the eye, is often unknown at the time and hidden by overlying soft tissues. Sharpening performed on a daily basis is rapid and efficient, requiring only a sharpening stone and, with many stones, special sharpening oil. It is important to avoid contamination of the stone – clean and sterilise (autoclave or cold sterilisation) instruments before sharpening, then wipe clean, pack and autoclave afterwards.
Instruments are most easily used when packed as kits, the author preferring a small breed/ feline kit separate to a standard canine kit, thus only the appropriate items are used or contaminated at any one operation. Different coloured instrument trays enable coding and easy identification, in addition to keeping instruments together. These, along with the hand instruments, are cleaned and sterilised in the same manner as any surgical equipment, usually for the appropriate cycle of an autoclave. During the cleaning process all edges and hinges should be checked, with any damaged items removed for repair or replacement.

Hand Instruments
Elevators – e.g. Couplands. Modified bone gouges. Sharp but robust. Wedging or rotation
Luxators – Modified scalpel blades. Sharp and slim. Apical movement into PDL space.
Forceps – 'paired elevators'. Robust. Used on roots (NOT crown). Expand the alveolus.

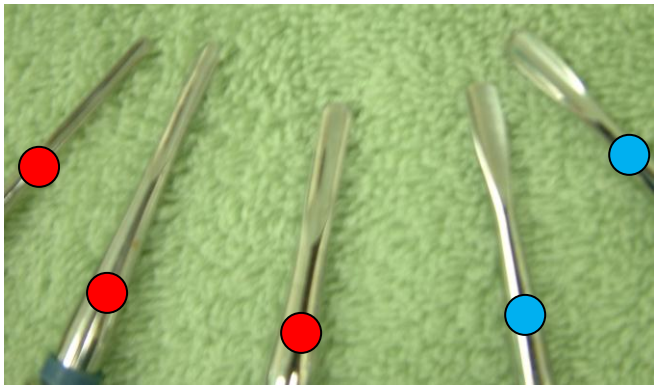


Fig 9: Elevators (red), luxating instruments (blue)
These instruments are held in a palm-grip. In the case of elevators and luxating instruments, the fore-finger is placed along the instrument's shank such that only a short portion of blade tip is visible beyond the finger-tip. The elevator is prevented from slipping far as the forefinger on the elevator acts as a 'stop', contacting the finger of the supporting hand – since only a tiny amount of blade protrudes beyond the forefinger tip of the dominant hand, minimal damage to either patient or operator is likely. Select appropriate patterns and sizes by matching the blade of the instrument to the curvature of the root circumference. This may vary with species, breed, tooth type and area of root selected to work on.

The opposite hand supports the area of jaw around the tooth designated for extraction, with the thumb and forefinger 'pinched' around the tooth. This counters movement during extraction and prevents unchecked trauma should slippage of the instrument occur.

All movements should be smooth and use controlled force. This gradually shears the periodontal ligament fibres and subtly expands the socket, enabling atraumatic extraction.

Never :
- use instruments like a crowbar
- lever off / use against healthy adjacent teeth
- rush extractions with excess force or rapid movements

Luxators/ Luxating elevators
Essentially modified scalpels, these sharp and slim instruments have delicate blades. They may be used to initiate extractions but do not use force or rotation.

Insert into periodontal ligament space, advance apically (towards root apex) with a forward and subtle rocking motion to allow the blade to find its path in the PDL space between root and alveolar wall. Instrument slippage is a major concern; ensure that a palm grip with finger stop is always used.

Elevators
Sharp but robust, these instruments are essentially a modified bone gouge.
They may be used between root and bone (or between multiple roots provided each is to be extracted), elevating teeth via wedging or rotational forces.

Wedging : apical advancement of the elevator between root and alveolar bone

Rotation: tension is applied to the root indirectly, using a fulcrum. Vertical and lateral rotation may be used. For each technique patience is required, applying controlled and balanced force for 10-20seconds.

Forceps
Used only on roots – will fracture or slip off crowns. Drive the blades below the gingival margin to engage on the roots, ensuring that gingiva is not trapped in the beaks.

Forceps have two blades 'beaks'; their inner curvature should match the curve of the root's outer circumference in order to prevent excess force being concentrated at spots on the tooth and leading to fracture or slippage. Few patterns exist for animals thus fit is often poor - do not use ill-fitting forceps.
Firmly grasp the root and, supporting the region of jaw, apply controlled apical (inward)force for 10seconds. Safe movement type depends on the shape of the root, underlying pathology and surrounding bone. A root with circular cross section may be loosened by rotation; this includes most premolar roots (except the distal root of UPM4). Where movement to loosen teeth is required, an apical force should also be maintained to ensure the tooth moves as a whole, rather than the cervical part fracturing.

Once a tooth has been loosened within its socket, use smooth, gentle force to further loosen and extract teeth, do ***not*** simply pull, rotate or lever the tooth as trauma is likely. Forceps are only used as the end stage of extraction, once the tooth is already appreciably mobile.

Periosteal Elevators
Used to lift mucoperiosteal flaps for surgical extraction by advancing between periosteum and bone.
The concave surface faces the bone and convex the periosteum; the sharp tip is directed downwards on to bone and gently rocked and moved across the bone to undermine the flap.

Fig 10: periosteal elevators
Held in a palm grip with finger stop. The opposite hand applies light force to tissue above the elevator's blade, providing a stop and reducing likelihood of upward blade movement and flap perforation.
Useful patterns include: **Dogs –** Goldman-Fox

Small dogs/cats – 2/4mm or 2/3mm (double ended)

Tooth Cutting
High speed hand-pieces rotate at 300,000-500,000rpm and are designed to cut tooth. They are very useful for sectioning multi-rooted teeth into individual root portions by cutting from the furcation towards the crown (away from soft tissue).

Hand-pieces should be held using the modified pen grip. This allows a secure grip, stability and support via a finger rest 'fulcrum' and fine control of bur direction.

Very light strokes should be used- do ***not*** press on the tooth – to prevent the bur jamming and stopping, damaging the hand-piece.

Ensure all hand-pieces are cleaned, oiled and autoclaved between patients.

Bone Cutting
A variety of instruments may be used for bone cutting, contouring and removal. Rongeurs ('bone nibblers') are ideal for contouring/ smoothing bone after surgical extractions. They offer rapid, simple bone contouring without risk of thermal damage and debris is removed within the beaks. Power equipment provides rapid removal and cutting of bone, however only appropriate types should be used. Both burs and bone rasps produce bone dust/ debris which should be removed.

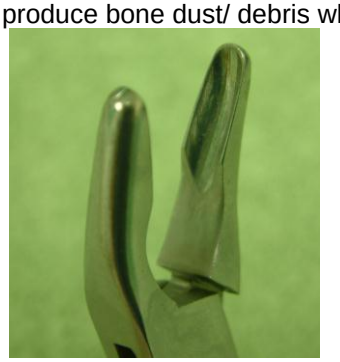


Fig 11: Rongeur 'beaks'

Low speed oral surgery hand-pieces rotate at around 10,000-40,000rpm and are designed to remove bone. They require irrigation via sterile bags of physiological solution e.g. Hartmann's solution or saline and provide the following benefits:

No air outlet towards tissue: prevents potential for emphysema and air emboli
No contaminated water and air to force microbes and debris into tissue
Directed cooling irrigant helps prevent thermal bone necrosis
Physiological , sterile irrigant used
Low-speed provides good tactile sensation feedback to the operator

Burs
Useful bur patterns include:
High speed – FG TC round size 0.5, 1, 2 (cats) 2 & 6 (dogs)
FG= friction grip TC=tungsten carbide
701L (fissure bur – to section teeth. dogs)
Low speed – HP TC round size 0.5 – 6 as above

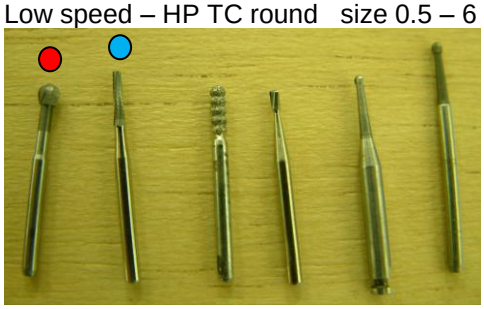


Fig 12: Burs; FG round size 6 (red), FG fissure bur (blue)

Techniques
Extraction is also referred to as 'exodontics' in many (primarily human) texts.

Closed Extraction
Also known as 'simple' / 'intra-alveolar' technique. No soft tissue flaps or bone removal is involved however multi-rooted teeth normally require division into individual root portions. Luxating instruments and elevators are used to displace the tooth within the alveolus. Forceps may be used on loosened teeth if necessary and if correct technique is used, with close fitting forceps.

Closed extraction technique is most appropriate where it is anticipated that extraction will not pose great difficulty. Criteria for inclusion thus include teeth with small single roots (e.g. incisors), normal root anatomy and mobile multi-rooted teeth. A pre-operative, diagnostic radiograph is thus required to correctly plan surgery.

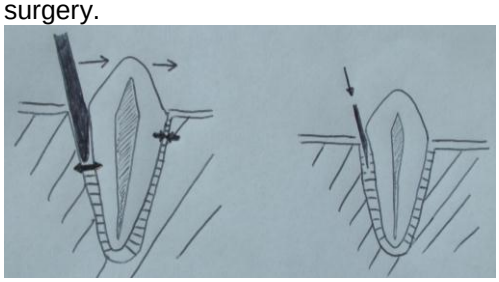
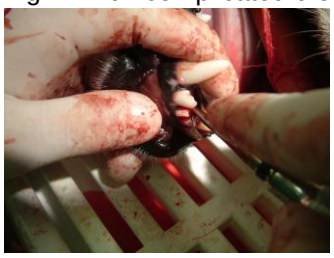


Fig 13: Advancing ('wedging') an elevator (left) and luxator (right)

Fig 14: 402 complicated crown fracture with exposed, necrotic pulp.



Figs 15-16: finger stop and support of lower jaw, use of elevator on labial (outer) and lingual (inner) aspects of 402. Adjacent teeth are healthy & would be contacted & damaged by use of the luxator between teeth. Loose 402 gently removed using forceps.

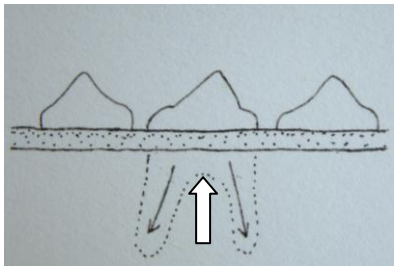
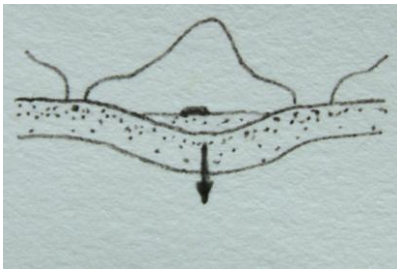



Fig 17-18:Furcation identification, double rooted tooth (white). Roots diverge. Gingival margin retraction may be required to visualise the furcation.

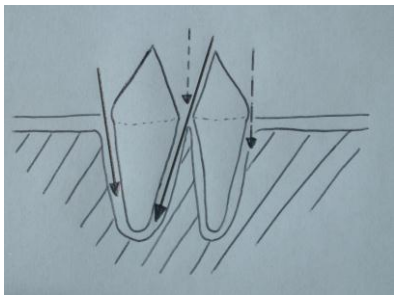


Fig 19: double-rooted tooth sectioned. Correct direction of elevator (solid arrow) parallel to root, within periodontal ligament space. Incorrect direction (into bone)= broken arrow.

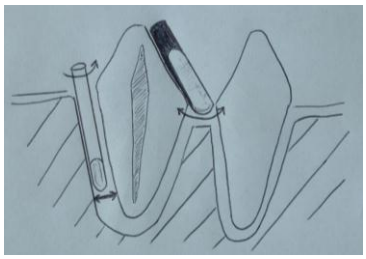


Fig 20: elevator rotation- vertical (left) & horizontal (centre. **Only** between sectioned roots of a tooth or between adjacent teeth which BOTH require extraction).

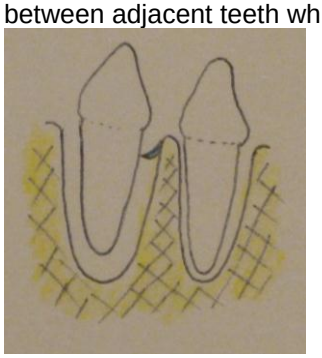


Fig 21: Elevator rotation between tooth root and alveolar bone

Surgical
Surgical ('open' /'trans-alveolar') extraction involves formation of a soft tissue flap to access the underlying alveolar (socket) bone, followed by removal of an amount of alveolar bone in order to better access tooth root and thereby facilitate extraction. Bone removal allows visualisation and removes some tooth support.

Essentials of flap design:

adequate size for visualisation and access to underlying bone
full thickness (mucosa + periosteum)
avoids unsupported suture lines
zero tension
base greater than gingival margin
base length exceeds flap depth
vertical releasing incisions, where used, are between teeth

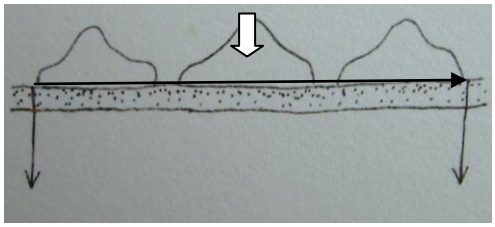


Fig 22: flap design with releasing incisions (black arrows) for extraction of tooth (white arrow)

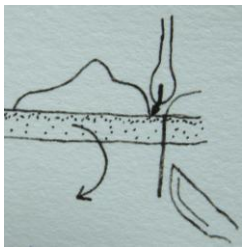


Fig 23: after releasing incisions are made with a scalpel blade, a periosteal elevator is used to ‘peel’ the periosteum from the underlying bone. The flap may then be reflected (arrow).

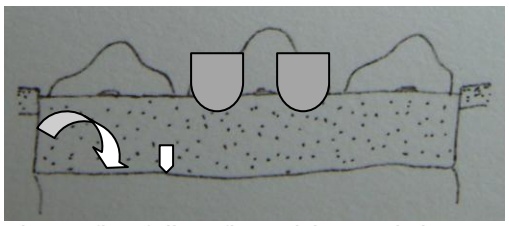
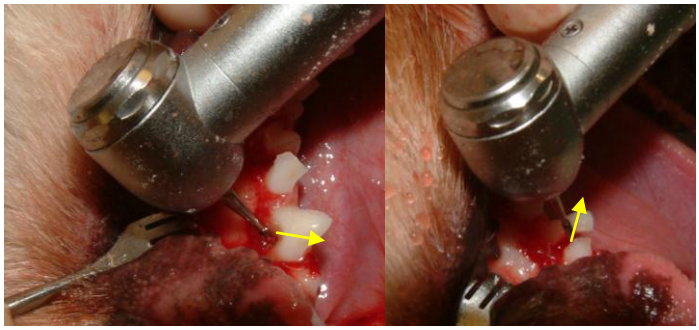
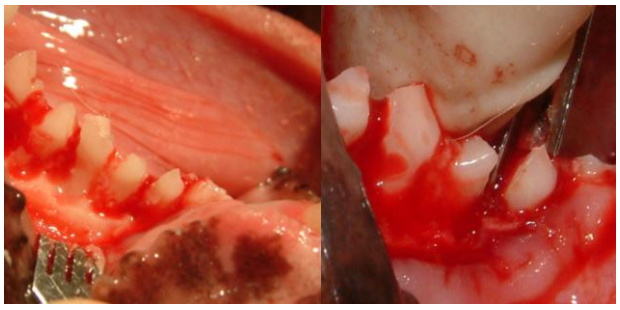


Fig 24: flap fully reflected (arrows), bone exposed (stippled). Bur-away thin bone overlying the roots in the cervical region to expose, but not cut into, the roots (U shapes of diagram) – see also Fig21.
Multi-rooted teeth are sectioned using a bur in a high speed hand-piece to create individual root-crown segments.



Figs 25-26: crown sectioning (arrow=direction)

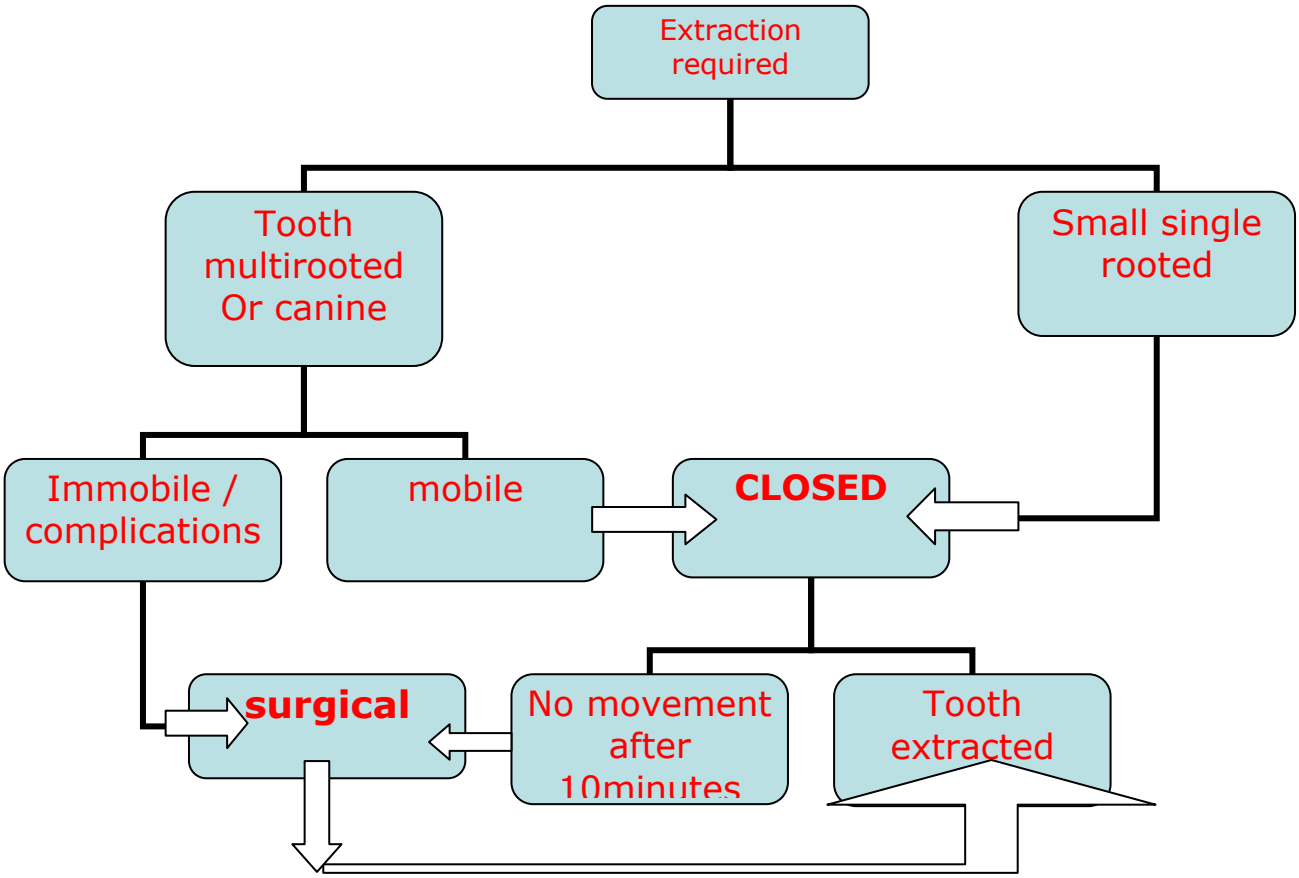


Figs 27-28: sectioned teeth, bone removed. Individual root-crown portions then elevated using techniques described in closed extraction (figs 13-21).

Surgical technique is often employed from the outset of an operation where a tooth is unlikely to be easily extracted via closed technique. Examples are canine teeth, immobile multi-rooted teeth, teeth affected by resorption (e.g. cats) or ankylosis (e.g. stone chewers). Other factors include concurrent disease e.g. periodontitis and bone destruction, and individual facial bone density and shape.

Pre-operative investigation and imaging will guide the operator to the preferred initial approach. Where difficulty is experienced during closed extraction, surgical extraction may be employed. Surgical technique may appear more invasive than closed technique, however, controlled, surgical procedures are far preferable to struggling with theoretically 'less traumatic technique' and resulting in tissue damage, healing delay and pain.
Analgesia for 2-7days post-operatively should be selected based on the procedure type and quality; greater pain and likelihood of infection is anticipated with increased exposure time and trauma.

Simplified algorithm for extraction technique selection:



Extraction of specific dentition is considered below. These are the 'structural' teeth; as such they tend to be more difficult to extract and more important to the animal. Conservative treatment options may be possible – where fracture is the pathology root canal therapy tends to be used in canine teeth. This maintains function, behavioural aspects, defence and facial shape.

Maxillary Canines
Surgical extraction is often the technique of choice to avoid iatrogenic damage to bone (e.g. crushing, splintering) and soft tissues (e.g. instrument slippage, maceration). Oro-nasal communication should be avoided, however, where this is suspected (DO NOT PROBE TO CHECK) surgical technique and successful closure healing will treat the complication.

One disadvantage of surgical extraction is the loss of the lateral bulge provided by the root and labial bone of the canine. This change in facial shape causes the upper lip to lie more vertically and thus may be caught by the tip of the ipsilateral mandibular canine. This does not occur in all cats but does cause irritation, trauma and ulceration in some. Careful closed extraction has the benefit of maintaining the shape but loss of the clot, healing delay, traumatic extraction or root remnant formation are potential disadvantages. The author routinely performs coronal reduction and odontoplasty of the mandibular canine to prevent lip trauma where surgical extraction of a maxillary canine is required.

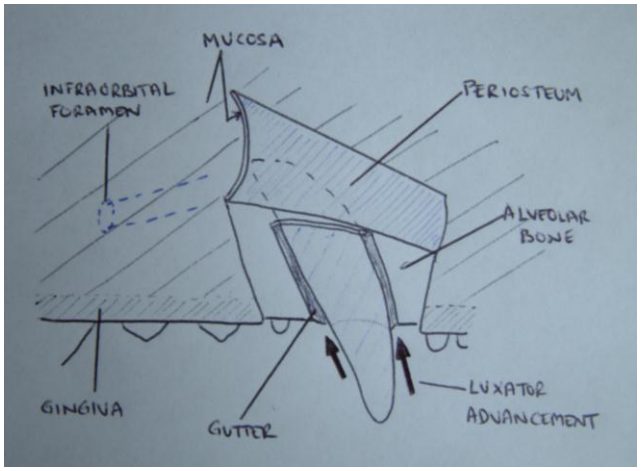


Fig 29: Surgical extraction of upper canines.

Maxillary Carnassial

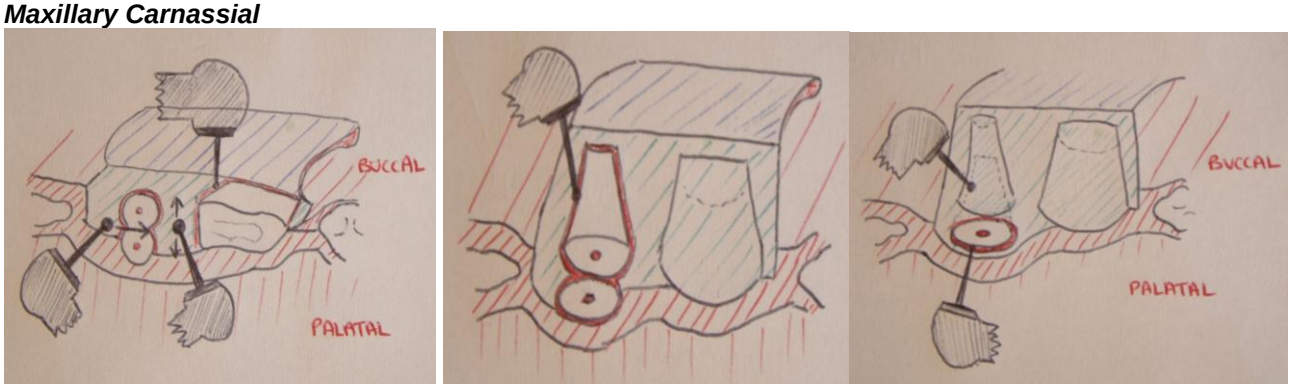


Fig30: Stepwise bone removal for surgical UPM4 extraction.

Be aware of the potential for oronasal or oroantral communication and the danger of root tip migration into these spaces or the infraorbital canal. The palatal root is especially liable to fracture.

Mandibular Canine

Ensure that the owners have consented with knowledge of potential complications e.g. jaw fracture. This risk can be reduced by patient, gentle technique and use of thin luxators. Rotation and forceful wedging should be avoided. Fracture is most likely where force is applied distally or mesially, between the canine and incisor or canine and premolar. Working on labial and lingual aspects carries lower risk of fracture, however care to avoid slippage and trauma to the floor of the mouth or mental nerve and vessels is required.

Ensure the mandible is supported by the non-working hand at all times. Coronal amputation can assist extraction however grasping the root for removal may be more difficult. Allow a generous amount of time for extraction.

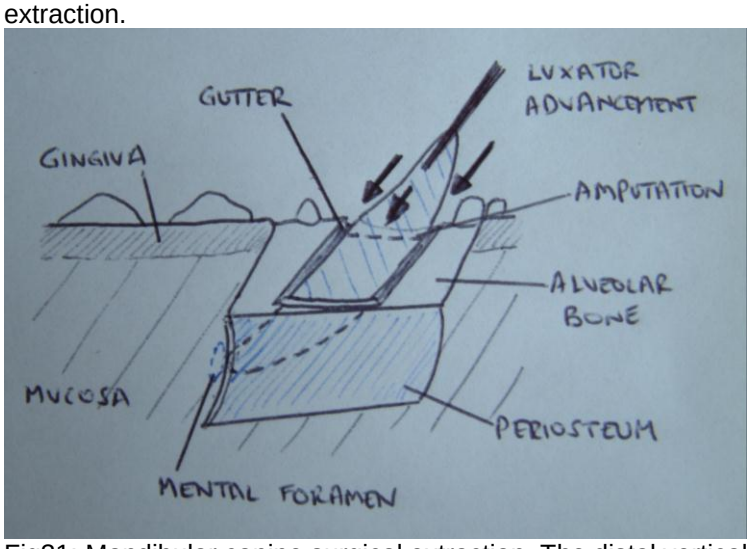


Fig31: Mandibular canine surgical extraction. The distal vertical relieving incision may be omitted to prevent iatrogenic damage to the mandibular neurovascular bundle; instead the horizontal incision may be extended further caudally along the gingival margin.

Mandibular Molar
The distal root is commonly fractured. Reduce the risk by sectioning the tooth into individual root portions first, amputating the crown of the distal root segment, then removing the mesial root before the distal. The robust mesial root is less likely to fracture and fragile distal root can be seen and pursued more easily in its ventro-caudal direction with the resultant space created.

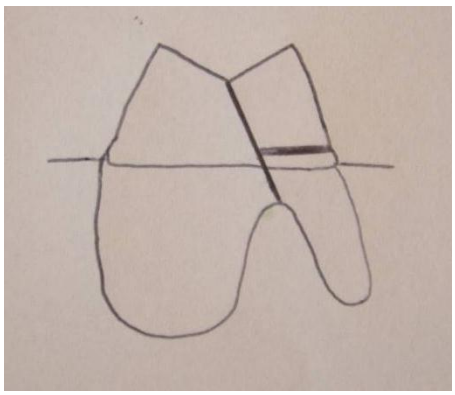


Fig32: Sectioning guide-lines for the lower molar.

Summary
Specific teeth and situations require technique variations to best achieve extraction as atraumatically as possible. The surgeon must assess the likely approach and complications in advance and be prepared to alter this based on radiographic or other investigations. For example, surgical extraction may prove necessary for a tooth which was originally deemed as suitable for closed extraction, due to ankylosis or root shape. The wise surgeon exercises caution, ensuring adequate time, correct equipment and appropriate training and skill before embarking upon surgery. Where root fracture occurs and concern exists regarding likely trauma in order to obtain the root tip, radiograph the area, irrigate with saline or Hartmann's solution and surgically close the site, provide analgesia and antibiosis for 3days, monitor and obtain an expert opinion. If in doubt prior to any procedure, seek advice and endeavour never to start something you cannot adequately finish.

Feline Oral Surgery: Extraction Complications

Tooth extraction is a frequent oral surgery procedure in practice. Indications include tooth fracture, periodontitis, caries, pulp death and resorption. Each tooth type has a specific anatomy and both this and neighbouring anatomy must be borne in mind before and during surgery.

Complications are a regular feature of extraction. While careful, correct technique minimises these, it is important to be aware of the potential damage types, their avoidance and subsequent treatment.
Complications
Soft Tissue Trauma
Gingival maceration
Mucosal perforation/ tear
Neurovascular bundle laceration
Flap dehiscence

Hard Tissue Trauma
Tooth fracture
Alveolar bone damage
Jaw fracture

Soft Tissue Trauma
Most soft tissue trauma is the result of instrument slippage through use of excess force. Careful control must be exercised and instruments, such as periosteal elevators, maintained with a sharp edge in order to minimise required force.

Accurate use of sharp instruments to initiate flap formation or extraction preserves the gingiva; both free edge and that attached to underlying alveolar bone.

Gingival maceration results in increased discomfort, delayed healing and, where associated with teeth to be preserved, compromise to their attachment and resultant viability.

Mucosa is a delicate and sensitive tissue; trauma leads to discomfort and healing delay. The likelihood of infection increases in any tissues suffering injury. The blood supply to other areas of flap tissue may be

damaged, particularly where tears run parallel to the gingiva (ie cut across blood vessels). While perforations and tears may not lead to total flap dehiscence, their size and position may compromise healing. Neurovascular bundle laceration may affect nerve, vein and artery. Total transection results in severe haemorrhage and permanent numbness of the innervated tissue area. Protection is afforded by applying gentle pressure onto bone, pushing the bundle away from incisions, whilst avoiding excessive finger pressure which may cause haematoma. The fingers remain in this location to prevent damage via instrument slippage.

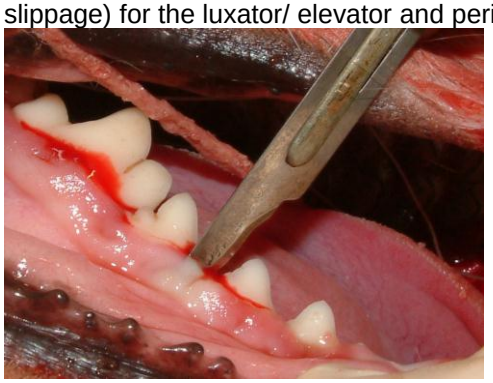
Haematoma formation is common with sub-total injury and is likely to be combined with neuropraxia. The neuropraxia (nerve 'bruising') may be temporary or permanent, however even temporary paresthesia is noted to last months in many human patients. Altered sensation may vary from numbness to 'pins and needles' to orofacial pain. Treatment of signs utilises anticonvulsants and antidepressants; analgesia is limited. Such damage may occur inside or outside of the nutrient (bone) canal. Without adequate retraction soft tissues such as the lingual frenulum and neurovascular bundles may easily become wrapped and torn by rotary instruments.

Flap dehiscence may occur secondary to rough handling or laceration as described above. A frequent cause of breakdown is suturing of flaps under tension. The oral tissues are less tolerant of tissue tension than skin and the resultant blood supply compromise will lead to flap failure. Tissue 'blanching' signifies capillary occlusion and hypoxic tissue damage will follow.

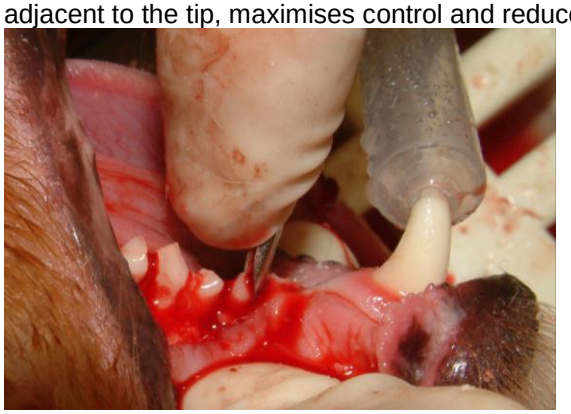
This may be avoided by appropriate choice of flap pattern and enlargement of flaps one or more methods:
Long horizontal releasing incision
Vertical releasing incisions
Increased undermining
Partial thickness (periosteal) releasing incision
The flap pattern must allow subsequent suture lines to be supported by underlying bone. This prevents excessive flap movement and resultant compromise.

Where extraction results in a large deficit (eg maxillary canine) flaps may be enlarged or alveolus left partly open where suturing would result in tissue tension.

The following pictorial steps will aid prevention of soft tissue trauma:
1) Horizontal releasing incision. Gingival attachment is cut by carefully running a scalpel blade within the sulcus. Delineation of flap perimeters is similarly achieved. This helps subsequent purchase (thus preventing slippage) for the luxator/ elevator and periosteal elevator respectively.



2) Finger stops. Positioning the forefinger close to the luxator or elevator tip and finger of the opposite hand adjacent to the tip, maximises control and reduces trauma (to patient and operator!) should slippage occur.



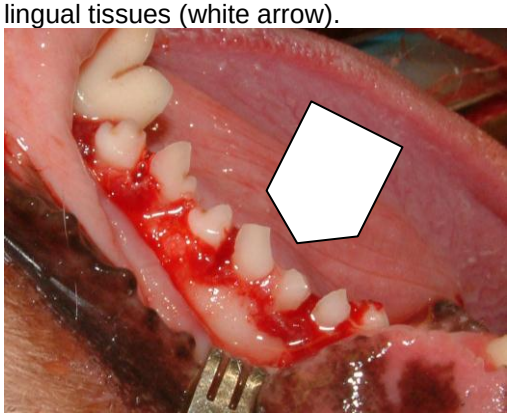
3) Flap creation. Finger positioning during periosteal elevator use is as described above. The forefinger of the non-operatory hand also guides the instrument tip downwards onto bone. This ensures clean lifting of the periosteum and reduces slippage or flap perforation.

Author prefers Goldman Fox for dogs, a 3mm and 2mm for cats/toy breeds

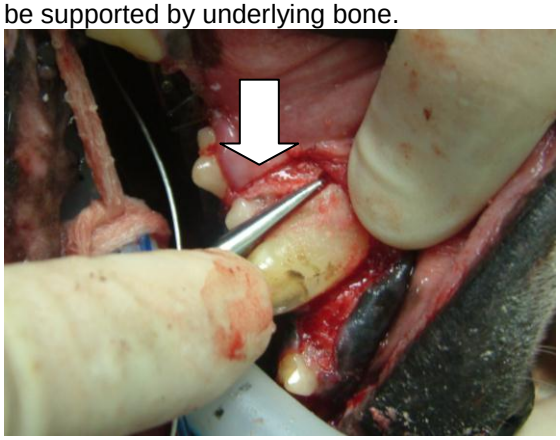
The periosteal elevator is used in a side-to-side fashion, releasing the full length of the flap before undermining proceeds further beneath the tissue. Areas where attachment is very tough (eg between canines and corner incisors, white arrow) should be approached first. The initial scalpel cut must reach underlying bone. A small, sharp periosteal elevator should be employed firstly to raise the corner region cleanly. This order reduces flap tearing and/ or perforation.

4) Soft tissue protection. Flaps should be protected from injury by minimising handling and using adequate retraction by stay sutures, Senn/ gingival retractors (photograph below) or atraumatic finger forceps eg Adson Brown.

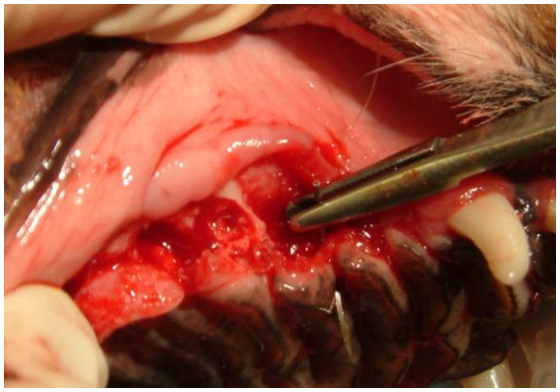
Lingual tissues are protected by placing a wooden or plastic spatula between area of bur usage and tongue/ lingual tissues (white arrow).



5) Suture placement. A flap pattern is chosen to ensure releasing incisions (arrow) and thus suture lines will be supported by underlying bone.



Sutures are placed within gingiva where possible and with good tissue ‘bite’ to enable secure anchorage. Reverse cutting, swaged-on needles minimise tissue trauma. Suture material is a foreign body and rapidly absorbable, monofilament (eg Poliglecaprone) or braided suture is advised. Suture strength for 7-10days is usually adequate. Sufficient sutures to provide stability and adequate closure are required (eg approx every 3mm), excess is contraindicated.



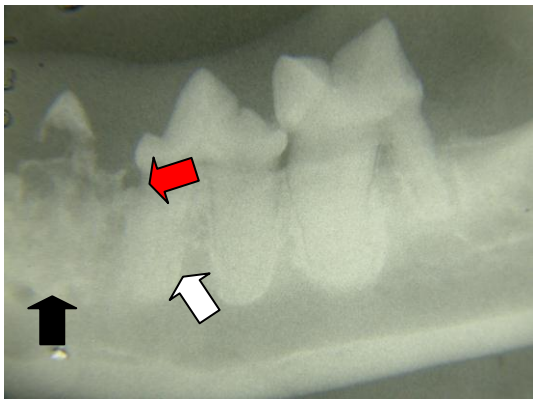
Wound breakdown with additional underlying bone loss has led to oro-nasal fistula formation. This requires additional surgery involving flap advancement to close the deficit.

Hard Tissue Trauma

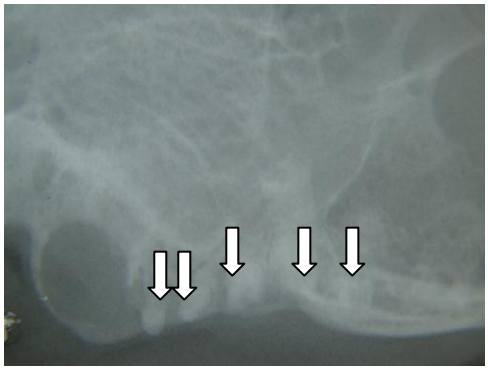
Tooth fracture is the most frequent hard tissue trauma met during extractions. Anatomical knowledge, prior radiographic evaluation of the area and gentle, patient technique minimises the tendency. Risk is increased by the following factors:

Abnormal anatomy
Ankylosis
Resorption

Resorption (external): 'ghosting' (tooth material replaced by bone - black arrow), tissue loss (red arrow) and ankylosis (white arrow) of roots secondary to resorptive lesions (RL/ FORL/ 'neck' lesions). Areas of tissue loss cause fragility while ankylosis complicates extraction. 'Ghosted' roots have no remaining anatomy to extract – coronectomy/ coronal amputation may be performed. A flap is raised, as for surgical extraction, ALL crown material amputated (ideally low speed, with sterile irrigant) then site closed with gingival sutures.



Root tips (white arrows) should be radiographically identified and removed. This is essential for large remnants (> 1-2mm) and any remnant from an infected tooth (e.g. historically broken tooth, abscess). In some cases referral for removal is required, as occurs in the human situation. Do NOT resort to atomisation – this is not a treatment.



Where complicating factors are apparent a surgical approach offers greatest visualisation, access and thus success. Initial attempts at root remnant removal should be performed under radiographic control and utilise surgical approach. Where difficulties are likely to occur, discussion with referral colleagues is advised.
It is important to avoid alveolus trauma and migration of roots to underlying bone canals during extraction attempts. Vertical pressure to root tips can result in their insertion and subsequent loss within nasal cavity or canals. The latter is most significant as it results in severe, chronic pain. Referral is advised as further neurovascular trauma may be caused during attempts at removal.

Alveolar bone damage may be thermal, due to inadequate irrigant cooling of the bur with saline or Hartmann's solution. Most frequently trauma is via crushing and splintering when using hand instruments. This may be subgingival and thus go undetected. Controlled, surgical bone removal is preferable to traumatic 'conservative' approaches as it results in less discomfort, better healing speed and lowered infection frequency. Where simple/ closed extraction may be difficult a surgical extraction technique is advised.

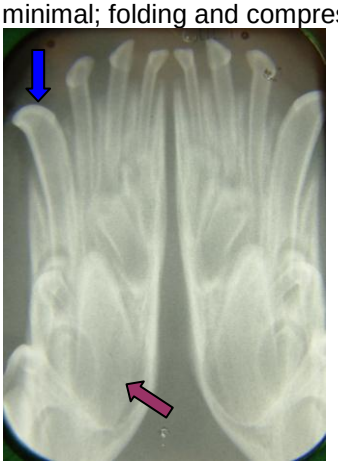
Bone loss and weakening due to periodontitis or periapical pathology may lead to teeth which are readily lost from the socket but result in defects such as oro-nasal fistulae. Such defects may result purely from high degree of bone destruction via disease or iatrogenically through use of hand instruments. With minimal bone to halt travel, 'easy' extraction cases may be most vulnerable to complications involving slippage and travel of instruments via bone into adjacent tissues which may include eye and brain, as well as nasal cavity or nutrient canals.

Human evidence shows risk of neurovascular trauma is increased in mandibular teeth where complications to extraction are noted (eg curved roots) and where radiographic evidence shows roots in close proximity to the canal. It should be noted that extraction of teeth may result in nerve damage even when the canal is not visibly entered or traumatised.

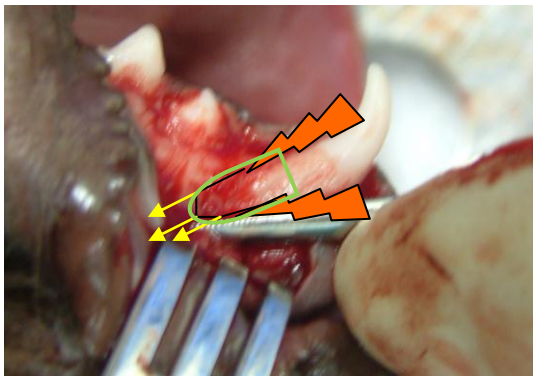
Jaw fracture risk is reduced through prior assessment by probing and intra-oral radiography of extraction sites. Bone weakening or loss may be found in areas of periodontitis, cyst formation, unerupted dentition, structural dentition (canines, carnassials) or tumours.

Surgical extraction technique employing controlled bone removal can aid atraumatic extraction by reducing force required.

In juveniles unerupted teeth are susceptible to trauma during extraction, trauma or fracture fixation. Deciduous (blue arrow) and unerupted, permanent dentition (purple arrow). Surrounding bone is soft and minimal; folding and compression injuries are likely.



A straight, cutting only action with a luxator (avoid rotation!) minimises likelihood of fracture along the lines of weakness (orange). The buccal bone window is made with a smooth base (green) to prevent fracture propagation lines (black to yellow).



Summary

While extraction forms a part of daily surgery the potential complications should be considered before embarking. Oral assessment by probing and intra-oral radiography is essential for appreciation of complicating factors and appropriate choice of treatment plan. Procedures for salvage in instances of complication must also respect adjacent anatomy in order to avoid further painful conditions for the patient.