
TREATMENT OF TOOTH FRACTURES BY RESTORATION, DIRECT PULP CAPPING AND EXTRACTION

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TOOTH FRACTURES ARE A COMMON DENTAL PROBLEM SEEN IN COMPANION SMALL ANIMAL PRACTICE WORLD-WIDE. FRACTURES MAY RESULT FROM CHEWING HARD ITEMS SUCH AS BONES AND ANTLERS, FENCES AND ROCKS, OR FROM A MOVING OBJECT SUCH AS A MOTOR VEHICLE, GOLF BALL OR SPORTING EQUIPMENT, I.E. CRICKET OR BASEBALL BAT AND GOLF OR HOCKEY STICK.

Fractures may be termed 'uncomplicated' and involve loss of enamel or dentine, or may be 'complicated' and expose the pulp. They may also be limited to the tooth crown, or may extend subgingivally and be termed a 'crown-root' fracture.

Treatment goals are: reducing pulp inflammation and/or infection; eliminating pain; and preventing further damage to the tooth. Treatment options include: extraction; root canal treatment or vital pulp therapy followed by crown restoration.

Many fractures are not observed by the owner at the time of injury due to the pet not showing obvious pain, so immediate therapy is infrequently performed in veterinary practice. The majority of tooth fractures are therefore found by the veterinarian during clinical examination of the oral cavity when the pet is presented for a general consultation, a health check or a vaccination. Because of this, the most common treatment for fractured teeth in veterinary medicine is root canal treatment or extraction.

In this case study, the dog was noticed to be involved in a motor vehicle accident and suffered trauma to the oral cavity, resulting in multiple teeth fractures. The referring veterinarian commenced antibiotics and NSAIDs immediately with the view of reducing inflammation and saving the teeth and the dog was presented at our clinic the same day as the accident.

Case Study

Abbey, a 40kg, 6yo female German Shepherd was referred following presentation at her regular veterinarian after a motor vehicle accident causing multiple fractured teeth on the day of the incident. The referring clinic had commenced Clavulox 500mg IM and Metacam 40mg SQ three hours prior to presentation. The oral examination revealed multiple teeth fractures. A dental chart was completed. The maxillary left 2nd incisor (202) and mandibular left canine (304) had complicated crown fractures. The mandibular left 1st and 2nd incisors (301, 302) had complicated crown-root fractures. There were multiple teeth with uncomplicated crown fractures with dentin exposure: 104, 108, 203, 204, 303, 401, 402 and 403. Clinical examination found Abbey to be healthy - T38.1C, HR 144, RR 12, mentation bright and alert, body condition score 6/9.

Pre-anaesthetic health check using IDEXX in-clinic machines showed the haematology and biochemistry parameters to be normal. Abbey was admitted and intravenous fluid therapy commenced using Hartmann's solution at 5ml/kg/hr after placement of an indwelling #20 catheter in the left cephalic vein. Anaesthesia was administered using buprenorphine 0.35ug SQ and atropine 2mg SQ pre-med followed by alphaxalone 60mg IV induction 30 minutes later. Abbey was monitored during

anaesthesia by measuring blood pressure, spO₂, temperature, heart rate, CO₂ and respiratory rate and kept warm using an air forced heating blanket. The fractured teeth were radiographed using a #2 Sopix sensor prior to treatment. There was an oblique root fracture associated with 302.

Figure 1. View of the rostral mandible showing the fracture to 301, 302 and 304.



Figure 2. Radiograph of the crown-root fractures of the 1st and 2nd incisor teeth and the apical root fracture of 302.

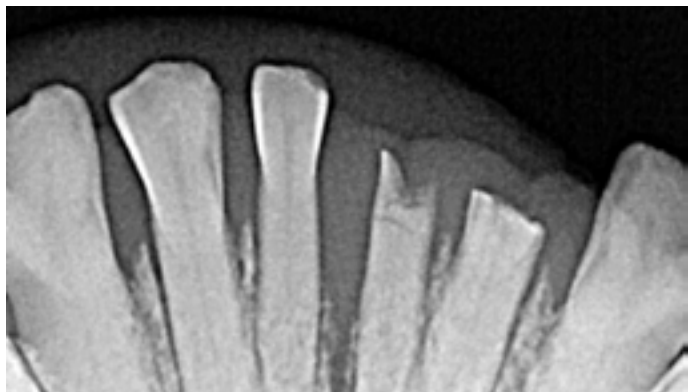
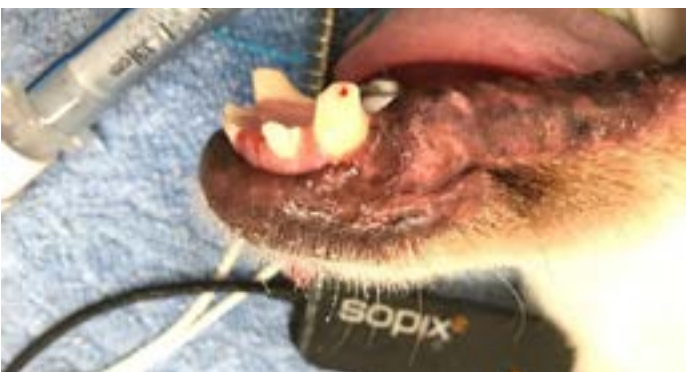


Figure 3. Lateral view of the rostral mandible showing the fracture to 301, 302 and 304.



Left sided infra-orbital and mental nerve blocks were placed using 0.5mls mepivacaine 3% solution each. Teeth 301 and 302 were extracted. Teeth 202 and 304 were treated by direct pulp capping. Flowable composite restorative was placed on the teeth with uncomplicated fractures.

Technique for extraction 301 and 302

The epithelial attachment of both mandibular incisor teeth was severed using a #15 scalpel blade placed into the periodontal sulcus. A 1.3S-XS and winged #1 elevator were then advanced subgingivally into the space occupied by the periodontal ligament. Apical progression of the instruments severed the

ligament and loosened the tooth from attachment to the bone with firm but controlled force. Once mobile, the teeth were grasped with small animal extraction forceps and gently removed from the socket with gentle rotation. 301 was removed entire, whilst 302 was missing the root tip. A radiograph was taken to confirm the root tip was still in situ.

Figure 4. Radiograph confirming the root tip of 302 in situ.



An attempt to extract the root tip using the 1.3S-XS and a root tip pick instrument was not successful, so a surgical extraction was performed. Two vertical diverging incisions were made commencing at the gingival margin on either side of the tooth extending into the mucosal tissue to the level of the tooth root to expose the overlying bone. A Molt 2/4 periosteal elevator was used to raise a full thickness muco-gingival flap and expose the underlying bone. Two mm of alveolar bone was removed with a #2 diamond bur in a high speed water-cooled handpiece to the level of the fractured tooth root. The Extract-Eze root tip remover was screwed into the pulp canal of the tooth root to stabilise it and the 1.3S-XS elevator was used to sever the remaining periodontal ligament. Once loose, the root tip remover was used to lift the tooth root from the socket. The gingival flap was replaced and sutured with 4/0 polyglycolic acid. Complete tooth removal was confirmed visually and by radiography.

Figure 5. Radiograph of 302 with root tip remover in place.

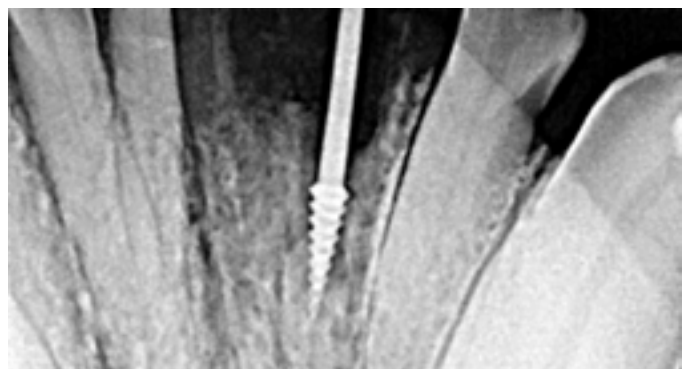


Figure 6. Radiograph confirming complete extraction of both 301 and 302.

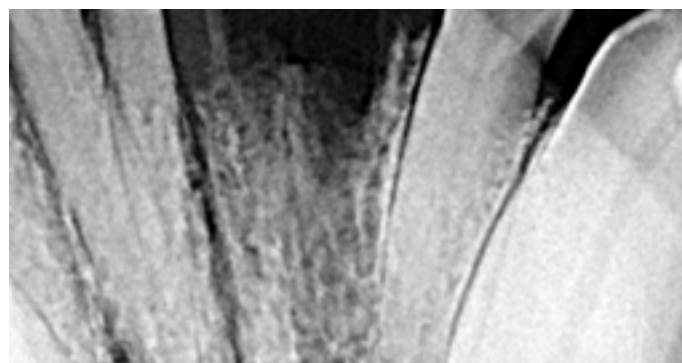
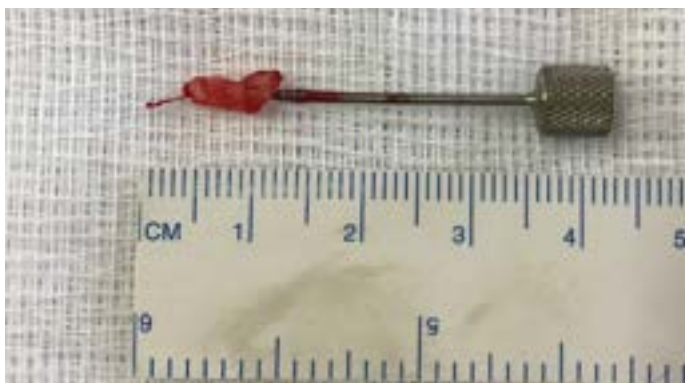


Figure 7. Extracted tooth root attached to the root tip remover.



Technique for direct pulp capping 202 and 304

The teeth were cleaned with a saline soaked swab and sterilised by washing in 0.12% chlorhexidine. A sterile drape was placed over the tooth isolating it from the surrounding tissues and previous surgery site. The exposed infected pulp and 5mm of coronal pulp was removed with a sterile water-cooled #2 round diamond bur in a high speed hand-piece. Haemostasis was achieved with a saline soaked paper point left in contact with the pulp stump for 10 minutes. Once the paper point was removed, hemostasis confirmed and the canal was dry, a 1mm layer of liquid calcium hydroxide paste was placed directly onto the exposed pulp stump using a calcium hydroxide applicator.

A 2mm layer of light-cured glass ionomer was placed directly onto the hardened calcium hydroxide surface and set using a blue curing light. The remaining 2mm of pulp canal and exposed fractured dentine/enamel surfaces were prepared for a composite restoration using the acid technique. 37% phosphoric acid was placed onto the exposed tooth surface using a micro-brush and left for 30 seconds, removed using the same brush, washed with water from the air/water syringe and dried with the same syringe until a frosted appearance. It is important not to dehydrate the surface, which will result in collapse of the intra-tubular collagen and reduced bonding and restorative strength. A thin layer of unfilled composite resin/bond was placed using a micro-brush to the etched tooth surfaces, air thinned using the air/water syringe and cured with the curing light for 10 seconds.

An A1 shade filled composite restorative was placed into the 2mm void within the pulp canal and over the coronal aspect of the fractured tooth using a plastic instrument to provide coverage and protection of the exposed dentine and enamel edges and re-establish normal tooth anatomy albeit to a shortened height. The composite was placed in 2mm increments and cured with a curing light for 10 seconds per cycle.

Once coverage and anatomical form was achieved, the composite was smoothed using Soflex finishing disks commencing with the course disk in a slow speed hand-piece with a mandrel attachment under water cooling from the air/water syringe and progressing through the medium, fine and super fine disks.

A final layer of unfilled resin was placed over the composite and tooth to seal the margin and provide a smooth finish. The resin was cured with the curing light for 10 seconds.

Technique for restorative 104, 108, 203, 204, 303, 401, 402 and 403

The restoratives were performed using composite and the acid etch technique as previously described.

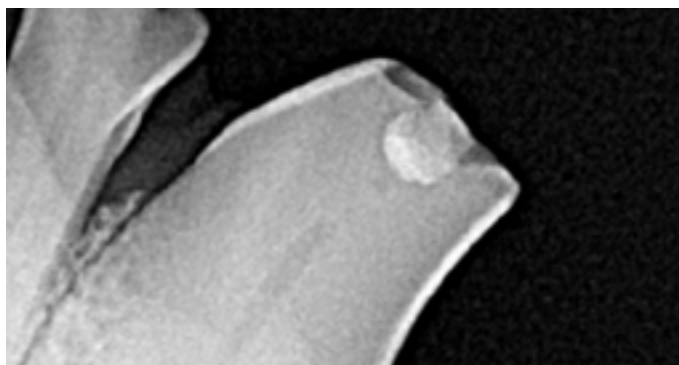
Abbey recovered well from anaesthesia. She was continued on Metacam 40kg body weight oral dose sid and Clavulox 500mg PO bid for 10 days.

Re-evaluation in 3 weeks showed healing of the sutured surgical site and retention of the restorations.

The owner was asked to offer food which could be compressed between the owner's thumb and forefinger, without being mushy until rescheduled radiographs would be obtained of the direct pulp treated teeth.

Follow-up including anaesthesia and radiographs were scheduled and performed five months post-op. Radiographs revealed healing of the extraction sites and formation of a dentinal bridge in the direct pulp capped teeth.

Figure 8. Radiograph of 304 with restorative in place and



Formation of a dentinal bridge.

The procedure of extracting root tips of traumatically fractured teeth can be a challenge. When the tooth roots are located in close proximity to the maxillary and nasal sinus, the mandibular canal, or deep in rostral mandibular bone, the addition of a root tip remover during the extraction process can both make for an easier extraction, as well as, prevent accidental penetration into the nasal cavity and mandibular canal of the tooth root.

Discussion

Direct pulp capping of an acute pulp exposure should be successful as there is minimal chance of pulp infection. A clear understanding of how inflammation in a low compliance system can cause ongoing damage to the pulp becomes critical in the decision making process, so when NSAIDs are commenced immediately post trauma, the pulp should not become inflamed to the point of necrosis.

The alternative to partial coronal pulpectomy and direct vital pulp capping is complete pulpectomy procedure (root canal procedure). In removing the entire pulp from the canal, the odontoblasts are also removed or damaged and dentine will no longer be produced to thicken the dentine layer, narrow the pulp canal and as such strengthen the tooth.

The endodontic debridement of the root canal will further damage and remove intraradicular and intracoronal dentin and cause changes in collagen cross linking and dehydrate the dentin. Published studies show a 14% reduction in strength and toughness of endodontically treated molars in people, resulting in a large relatively brittle canal that is more at risk of fracture than a healthy tooth with a vital intact pulp.

An aesthetic consideration following complete pulpectomy is discolouration of the tooth due to an immature tooth having limited dentin formation. The decision in this case was to perform a direct pulp capping procedure due to the acute nature of the pulp exposure.