

# Non-surgical retreatment of a central incisor following dental trauma

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## Introduction

A 20-year-old woman was referred suffering from occasional, spontaneous toothache around the maxillary right central incisor (UR1). This radiated to an area underneath the nose and varied in intensity, but could be sufficiently bad to disrupt normal activity, such as driving a car. She was unable to bite on the tooth without discomfort.

When she was nine years old, she had tripped and fallen onto a post, traumatising the UR1 and causing an enamel-dentine fracture that did not expose the pulp.

From the patient's perspective everything appeared to be fine until about three years after the accident, when the UR1 started to become painful to bite on and the gum was sore. The general dental practitioner root filled the tooth and it settled down.

More recently, this young lady had become very conscious of the tooth darkening and sought the opinion of a new dentist to see whether a veneer was feasible. When a periapical radiograph was exposed it showed a poor root filling and large apical radiolucency.

Her medical history was uncomplicated, and apart from an allergy to penicillin, she was fit and well.

This article describes the non-surgical retreatment of a central incisor that had previously suffered trauma. The immature root was managed using a biological approach with micro-endodontic techniques.

## Clinical examination

Intraoral examination revealed that the UR1 was tender to percussion. It was not abnormally mobile nor was it ankylosed. The colour was significantly darker than the adjacent incisor teeth with a Vita equivalent shade of C3/C4 compared with healthy teeth at A2.

Photographs were taken for patient records at this point. There was an incisal/buccal composite restoration that was no longer a good colour match and had visible margins.

Soft tissue examination revealed no buccal swelling but the mucosa was tender over the apex of UR1 and a sinus tract was present.

Sensitivity testing with Endo-Ice (Coltene) and electric pulp testing (Sybronendo Diagnostics Unit) revealed that the UR1 was the only non-vital incisor tooth.

Paralleling periapical radiographs were exposed of the central incisor teeth using a Rinn Holder (Rinn, Dentsply) and all looked normal apart from the UR1. An attempt had been made to root fill the UR1 but the obturation material was significantly under-condensed in the apical third, and individual gutta percha cones were visible.

The dentist had clearly had difficulty managing the immature canal. They may also not have had confidence fitting rubber dam on a 12-year-old, increasing the potential for bacterial contamination of the root canal. The coronal restoration provided an inadequate seal. The root length of UR1 was significantly shorter than the UL1 and a large radiolucent area was present at the apex. No evidence of replacement resorption,

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Figure 1: Shows the maxillary anterior teeth. The UR1 is noticeably discoloured.



Figure 2: A paralleling radiograph showing the root filling in UR1 and large periapical radiolucency.



Figure 3: A microscope view into the access cavity; IRM has been placed over the Biodentine to act as a barrier for placement of bleaching material.



Figure 4: Endoperox, a carbamine peroxide material for internal bleaching.

inflammatory resorption, or any root fractures could be detected.

### Diagnosis

Although there was history of trauma, the most likely cause of current symptoms and clinical findings was periapical periodontitis.

The root canal filling had most probably failed as a result of persistent bacterial infection in the root canal. The tooth had not undergone replacement or inflammatory resorption.

### Treatment options

The treatment options were as follows:

1. Root canal retreatment and restoration with composite
2. Extraction and replacement with a Maryland bridge or implant-supported crown.

The prognosis for root canal retreatment should be good and

the patient could expect the tooth to remain functional for many years. Replacement at an early age with an implant may provide a good cosmetic result initially, but over a lifetime the result would be difficult to predict.

Generally, well root filled and restored teeth appear to function as well as single tooth implants and result in less costly repairs when things fail (Hannahan and Eleazer, 2008; Pennington et al (2009); Torebinejad et al, 2007). The dark colour of the tooth (and the main complaint of the patient) could be improved by:

- Internal bleaching
- Internal/external bleaching using trays
- Placement of a veneer in composite or porcelain
- Placement of a crown.

Bleaching techniques are low risk, and non-invasive (Zimmerli, Jeger and Lussi, 2010). Bleaching would, therefore, be the preferred means of improving tooth colour.



Figure 5: The completed restoration following bleaching

Matching the texture and colour of adjacent teeth with a porcelain or composite veneer on a single tooth would be aesthetically challenging and preparation of a crown unjustifiably destructive.

After discussion with the patient an internal bleaching technique was the option of choice.

### Treatment

Due to the history and chronicity of the infection, a two-visit strategy was adopted. This ensured adequate disinfection of the root canal and the possibility to confirm healing of the sinus tract before obturation.

Buccal infiltration of 4% articaine 1:100,000 adrenaline (Septodont) provided profound anaesthesia and the UR1 was isolated with latex rubber dam and a number one clamp.

Using an operating microscope the existing filling was removed with a long-tapered diamond bur, and soft dentine (the result of microleakage) with a tungsten carbide LN bur (Dentsply). This revealed a contaminated root canal containing poorly condensed gutta percha. The root filling was rapidly removed with Gates Glidden size two and Hedstroem file size 30 (Dentsply Maillefer). The loose gutta percha points were washed out of the canal with sodium hypochlorite.

The apical foramen of the canal was large (greater than a size 40 file) and could be visualised through the operating microscope. The coronal access was refined and a working length estimation made with an apex locator (Endo Analyzer, Sybron) and size 40 Flexofile (Dentsply Maillefer). A steady zero reading was achieved and this was confirmed by direct sight.

Because the root had an immature morphology there was no requirement for mechanical instrumentation. Instead, the canal was disinfected with a solution of heated 3% sodium

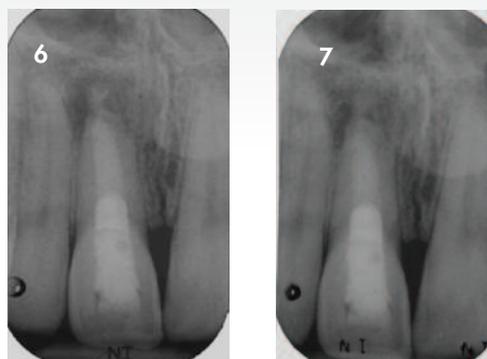


Figure 6: A radiograph showing the completed non-surgical retreatment. There is good homogeneity between the various layers of material.

Figure 7: The review radiograph at three months shows evidence of a reduction in the size of the periapical radiolucency. This, combined with absence of clinical signs and symptoms, indicates good early signs of successful treatment

hypochlorite (Teepol) irrigant, delivered using a safe-ended needle (Henry Schein) bent short of the working length to prevent extrusion.

Disinfection was carried out over approximately 40 minutes. The sodium hypochlorite was agitated with a size 20 Irrisafe ultrasonic tip (Satelec) and an Endoactivator (Dentsply Maillefer) with a blue tip. The solution was replenished every two minutes. A final sequence with 40% citric acid (Cerkamed) and 3% sodium hypochlorite completed irrigation.

The canal was dried with sterile paper points (Dentsply Maillefer) and non-setting calcium hydroxide placed (Calasept). The access was sealed with a cotton wool pellet at the level canal orifice, Cavit (ESPE) and Fuji IX (GC).

One week later the sinus had healed, the tooth was symptom free, the canal dry, odour-free, and the tooth ready for obturation.

The apical portion of the canal was sealed with Biodentine (Septodont), packed into place using a Machtou plugger with the microscope providing direct vision. On top of this, a layer of IRM (Dentsply) was placed. Endoperox (Septodont) internal whitening agent was mixed and packed into the access cavity. This was then sealed with Fuji IX compomer.

After a further week the tooth was reviewed. The tooth was symptom free and the patient was happy with the colour, so the access was permanently restored with Fuji IX, light-cured bulk fill composite SDR (Smart Dentine Replacement, Dentsply) and Ceram-X Duo (Dentsply). The incisal tip was restored with Ceram-X Duo.

The tooth was reviewed at three months, when it was symptom and sinus free and a paralleling radiograph showed good evidence of early bony healing at the apex.

A further review will be carried out at one year and subsequently at two and four years or when bony healing is complete.

### Discussion

The International Association for Dental Traumatology (IADT) has produced guidelines for the management of traumatic injuries to teeth, available online as the dental trauma guide (2010).

The recommended treatment for an enamel-dentine fracture is as follows:

1. If a tooth fragment is available, it can be bonded to the tooth. Otherwise, perform a provisional treatment by covering the exposed dentine with glass-ionomer or a permanent restoration using a bonding agent and composite resin

2. The definitive treatment for the fractured crown is restoration with accepted dental restorative materials

3. Three angulations (periapical, occlusal and eccentric exposures) should be used in the radiographic examination to rule out displacement or fracture of the root

4. Radiograph of lip or cheek lacerations to search for tooth fragments or foreign material

5. Follow-up – clinical and radiographic control at six to eight weeks and one year

The importance of checking adjacent teeth cannot be overemphasised as it is not uncommon for collateral damage to have occurred as a result of trauma.

Data from the dental trauma guide shows prognosis for an enamel-dentine fracture at one to three years to be very good, with the risk of pulp necrosis to be only extremely low.

This suggests that the initial injury in this case may have been more severe. The root length of UR1 was shorter than UL1 and the root morphology immature, suggesting that root development had stalled shortly after injury.



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Ravn (1981) evaluated the prognosis for permanent incisors with enamel-dentine fracture only and those with enamel-dentine fracture combined with other factors. Pulp death occurred in 3.2% of teeth with enamel-dentine fracture as the only damage. Enamel-dentine fracture and concussion resulted in pulpal necrosis in 5.8%, and cases involving both concussion and mobility showed pulpal necrosis in 30.1% of teeth.

Teeth with combined intrusion injuries would have a much higher incidence of pulp necrosis (67.6% at one year and 70.9% at three years), inflammatory root resorption approximately 35% at one and three years, and ankylosis 8.8% at one year and 12.1% at three years (Diangelis et al, 2012).

This confirms the requirement for meticulous examination of dental trauma cases and the potential risk of combined injuries. Compliance of the patient and parents to attend review is critical.

Limited volume, high resolution cone beam tomography can be useful in the assessment of trauma cases and the detection of resorption defects in endodontics. Evidence based guidelines for the clinical use of CBCT, known as the European Commission Radiation Protection guidelines (SEDENTEXCT 2012), and those from the American Association of Endodontists (2011), both recommend that the need for a CBCT scan should always be assessed after a risk versus benefit analysis before each exposure.

In this case, the tooth had been traumatised 11 years earlier; it was not ankylosed and showed no sign of inflammatory resorption clinically or on radiograph. The risk of both following trauma is highest in the first three years (Diangelis et al, 2012).

It was therefore considered more likely that the tooth had become necrotic after injury and the radiolucent area was the result of apical periodontitis; this was also confirmed by the presence of a sinus tract. The root canal was likely to be infected with bacteria and so there was no indication to expose a CBCT scan at this stage.

It is important in root canal retreatment to remove the failed root canal filling material as efficiently as possible to allow disinfection of the root canal (Van Nieuwenhuysen, Aouar and D'Hoore, 1994). During retreatment the existing material and any obstructions and missed canals should be prepared and disinfected at the first visit.

### Two-visit approach

Historically, it has been shown that mechanical preparation alone reduces the bacterial load in an infected root canal,

according to Byström and Sundqvist, (1981) but sodium hypochlorite in a concentration of at least 1% is required to kill any remaining bacteria (1983). Sodium hypochlorite also dissolves necrotic pulp tissue. The bacteria are present in planktonic form and as a biofilm; the latter are surrounded by matrix and can be difficult to remove.

The irrigant must therefore be agitated to break up these bacterial aggregations. Ultrasonic activation removes more debris from the root canal than syringe irrigation alone (Burlinson et al, 2007).

A solution of 17% EDTA or citric acid as a final rinse (Byström and Sundqvist, 1985) is used to remove smear and has a positive benefit on outcome in retreatment cases (Ng, Mann and Gulabivala, 2011).

In this case the root canal had an immature morphology, and the terminal foramen was greater than a size 40 file. There was no requirement to carry out mechanical instrumentation as the canal was already sufficiently large to allow adequate irrigant interchange. Instead, the irrigant was activated with an ultrasonic tip, which was lightly brushed against the walls and oscillated passively in the lumen of the canal with the hope of inducing acoustic microstreaming (Ahmad, Pitt Ford and Crum, 1987). The aim was to break up biofilm and remove contaminated surface layers of dentine.

Dressing the canals (after preparation and disinfection) with calcium hydroxide for seven days was shown to be effective at producing bacteria-free canals and so evolved the concept of a two-visit strategy using a chemomechanical approach (Byström, Claesson and Sundqvist, 1985; Sjögren et al, 1991).

More recently, universal use of a two-visit approach has been questioned. Peters and colleagues (2002) concluded that a calcium hydroxide and sterile saline slurry limits but does not totally prevent regrowth of endodontic bacteria. In a systematic review of the literature, Hargreaves reported that multiple visits with calcium hydroxide treatment did not improve upon clinical outcome and there was a minimal level of evidence for considering one versus two appointments in non-surgical endodontics (2006).

Indeed, a single visit approach is used by many endodontists for many cases with no apparent repercussions for the patient nor reduced prognosis (Ng, Mann and Gulabivala, 2011).

However, not all cases are ideally suited to a single visit approach and a two-visit strategy was adopted in this case to confirm resolution of the sinus tract before obturation and bleaching.

The immature root canal morphology can be challenging to obturate. Lateral condensation is difficult even with customised gutta percha points and excessive lateral pressure could potentially damage the thin root. Vertical compaction of gutta percha could result in extrusion of material unless a barrier or matrix is used at the terminal foramen. With the aid of an operating microscope the terminus of the canal can often be visualised and controlled placement of materials such as MTA (Dentsply) or Biodentine (Septodont) can be achieved. Bioceramics such as these have excellent sealing abilities and have many reported uses in endodontics, including management of open apices (Parirokh and Torabinejad, 2010).

It was possible in this case to accurately place Biodentine without using a collagen matrix at the apex.

Tooth discolouration occurs as a result of the formation of chemically stable chromogenic products; these are oxidised during bleaching. Most discolourations can be reliably bleached apart from those that result from metal ions (Plotino et al, 2008).

Tooth whitening following root canal treatment can be carried out using an internal bleaching technique (walking technique) with materials such as sodium perborate, or carbamine peroxide sealed in the access cavity (Zimmerli, Jeger and Lussi, 2010) or via an internal/external approach with carbamine peroxide solutions (Poyser, Kelleher and Briggs, 2004). According to Carraso and colleagues, carbamide peroxide has been shown to have the best penetration into dentine (2003) and the walking technique a better outcome than in-office bleaching (Dietschi, Rossier and Krejci, 2006). The internal/external technique requires the fabrication of bleaching trays and the access cavity can become contaminated with food particles and debris during use.

Endodontic bleaching has been cited as a possible cause of external cervical resorption (Heithersay, 1999), however, the etiology of this condition is not entirely clear. Defects in the cementum layer could potentially allow hydrogen peroxide from the pulp chamber to reach the external root surface and induce an inflammatory response (Rotstein, Torek and Misgav, 1991). Subsequent damage to the periodontium could therefore result in cervical resorption. Avoiding placement of internal bleaching agents below the Cemento-Enamel Junction, checking for cervical lesions and not using heat, should prevent external cervical resorption (Patel, Kanagasnam and Pitt Ford, 2009).

After checking to make sure that there were no cervical defects, intermediate restorative material was placed over the gutta percha root filling material and at the cervical level

of the root canal. Sodium perborate mixed with water is considered safer than hydrogen peroxide as an intracoronary bleaching agent and 35% carbamide peroxide (urea peroxide) combines the safety of sodium perborate together with the efficacy of 35% hydrogen peroxide (Lim, 2004).

In this case, an internal bleaching technique was used with a commercially available material: Endoperox (Septodont), a carbamine peroxide material.

The case was reviewed at three months and will continue to be reviewed at one year, two years and four years post treatment (European Society of Endodontology, 2006) or until complete bony healing occurs.

## Conclusion

This case highlights the management and diagnosis of periapical periodontitis in a tooth that suffered dental trauma 11 years previously. Non-surgical microendodontic techniques were used to retreat the immature root morphology. No mechanical instrumentation was required and the immature root was sealed with Biodentine. Internal bleaching as a non-invasive means of restoring natural colour was demonstrated in this non-vital tooth.

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