

Root Canal Retreatment: I. Case Assessment and Treatment Planning

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Abstract: Root canal retreatment is often the preferred method of treating a tooth in which root canal treatment has failed. Part one of this two-part article discusses reasons for failure of root canal treatment, case assessment and treatment planning. Part two describes some of the practical techniques that are available to the practitioner and the rationale for root canal retreatment.

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Clinical Relevance: Root canal retreatment may prevent unnecessary extraction in a root-filled tooth with persisting apical periodontitis.

The success rates for root canal treatment have been widely quoted¹ and there is marked variation in the ability of operators to achieve successful results. In many countries, studies using data collected from general practice have shown relatively low success rates for root canal treatment. A recent study in England and Wales showed that 97% of molar root canal treatment and 84% of canine and incisor root canal treatment had technical difficulties;² in a Scottish study, over 58% of root-filled teeth showed signs of periapical radiolucency.³ Similar radiographic results have been found in studies from

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the USA, Holland and Sweden.^{4,5,6} At the other end of the spectrum, studies using samples derived from teaching hospitals have shown much higher success rates 70–95%.¹

So why is there such a difference, and why do root canal treatments fail?

FAILURE OF ROOT CANAL TREATMENT

Biological failings of root canal treatment include:

- No rubber dam;
- Incorrect irrigants;
- Inability to prepare the canal to length;
- Missed canals;
- Poor obturation.

Other causes of failure include:

- Root fracture;
- Poor coronal restoration;
- Resistant bacteria;
- Economic constraints.

Biological Failings

Rubber dam

It is considered mandatory by dental teachers and endodontic specialists to use rubber dam for root canal treatment for many good reasons. Certainly, in the litigious environment in which we now work, it is a foolhardy practitioner that does not use rubber dam during root canal treatment. The benefits of rubber dam are that it:

- Protects the airway;
- Prevents microbial contamination;
- Reduces microbial aerosol;
- Retracts the soft tissues;
- Gives unimpeded vision, useful with magnification;
- Allows the operative field to be dried;
- Allows the safe use of sodium hypochlorite;
- Allows treatment to be quicker and more pleasant.

Rubber dam is inexpensive and easy and quick to apply.⁷ If the dam is stretched over the frame before treatment, then a single tooth can be isolated in a matter of seconds.

Surveys that have been carried out amongst general dental practitioners show that the majority of root canal treatment is carried out without rubber dam.^{8,9} The practitioners that do not use rubber dam also tend not to use chemically active irrigants such as sodium hypochlorite. This factor has a significant bearing on the success rate of root canal treatment. It is acknowledged, however, that it has not been proved that the use of rubber dam

increases success rates.

Appropriate Irrigants

Sodium hypochlorite is the recommended primary solution for use as an irrigant; in a concentration greater than 1% it is effective at killing bacteria and breaking down organic material. Irrigants such as chlorhexidine and iodine in potassium iodide have also been advocated as adjuncts to sodium hypochlorite; both have antibacterial properties but do not aid the dissolution of organic material. Irrigants such as local anaesthetic or saline have no biologically active properties and will not aid the dissolution of organic material or killing of bacteria. The modern rationale for root canal treatment involves a chemo-mechanical approach; bacteria are removed during preparation, mechanically by instruments and also by irrigants which penetrate the complex internal anatomy of root canal systems.

Inability to Prepare to Length

Failure to achieve patency to the apex of the root canal can be a result of attempting to gain access to the apical part of the root canal too early in the preparation sequence. With outdated techniques such as the stepback method,¹⁰ files tend to bind in the coronal aspect. Pure filing techniques can be fraught with instrumentation errors, such as zips and elbows, as the use of stiff stainless steel files tends to straighten canals which can be easily blocked with dentine chips.

Modern preparation techniques and rotary nickel-titanium instruments use a crown-down approach.^{11,12} The coronal aspect of the canal is prepared first, allowing much better access to the apical part. The development of nickel-titanium files (with tapers greater than standard hand files) has eliminated the need to step back, speeding up preparation and reducing the number of instruments that are required. These developments have improved the ability to prepare canal systems predictably, preventing blockage.

Missed Canals

Quality endodontic treatment is much

easier to achieve when good illumination and magnification are used. Most specialist practitioners routinely use operating microscopes; however, loupes with direct illumination are commonplace in general practice and should be used routinely. Retreatment is much more complex than initial treatment and many of the techniques that are described in this pair of articles cannot be used effectively without some form of magnification.

Poor Obturation

Modern obturation techniques using thermoplasticized gutta-percha, compacted either laterally or vertically, aim to obliterate more of the complex root canal system than single cone or silver point techniques, which are now considered obsolete.

Root Fracture

Root fracture is a common cause of failure in root-treated teeth. The importance of cusp coverage restorations in posterior teeth, especially when one or both marginal ridges have been lost, cannot be overstressed. Posts now tend to be used more conservatively, as they do not strengthen teeth and tapered screw posts are generally to be avoided. A periodontal probe may be used to assess the possible position of a longitudinal root fracture. A deep narrow pocket may indicate a fracture line. Similar pockets on opposite sides of a tooth are pathognomonic.

Poor Coronal Restoration

There has been significant interest in the importance of the quality of coronal seal and hence coronal restoration. It would appear that coronal seal does have an important bearing on the success rate of the root-filled tooth.¹³ The aim of treatment is to achieve a total seal, from apex to the oral cavity (having thoroughly cleaned the root canal system) to prevent the ingress of bacteria into the internal environment. Good root canal treatment with good coronal restoration achieves the best outcome, whereas poor root canal treatment and poor coronal seal

inevitably lead to failure.^{14,15}

Resistant Bacteria

There are bacterial species, e.g. *Enterococcus faecalis*, that are able to survive in root canals where calcium hydroxide has been placed. Alternative medicaments such as iodine-based materials have been indicated to kill these organisms. This situation is more common in retreatment cases where the microbial flora may be different from that found in initially infected canals.¹⁶

Economic Constraints

Poor remuneration and time constraints on practitioners are often cited as the reason for poor quality root canal treatment.⁹ Providing quality endodontic treatment is time-consuming. Attempting to achieve the desired goals faster and with insufficient time results in the biological treatment aims not being met and probable endodontic failure. A total of £52,733,081 was spent on root canal treatment carried out under NHS contract in the UK in the year ending March 2002.¹⁷ If a significant amount of this treatment proves not to be successful, is this money well spent? Interestingly, the method of remuneration does not appear to make a big difference to the quality of root canal treatment on a global scale.⁹

ASSESSMENT OF SUCCESS AND FAILURE

Current guidelines indicate that root-filled teeth should be reviewed radiographically for up to 2 years and, in certain cases, up to 4 years to assess whether treatment has been successful.¹⁸ Success would be indicated by relief from symptoms, healing of sinus tracts, and reduction or complete resolution of periapical radiolucency.

Assessment for Retreatment

If root canal treatment has failed, there are usually four possible treatment options:

- Review;
- Root canal retreatment;

- Root end surgery;
- Extraction.

Review

There may be occasions where a more conservative approach is appropriate. Perhaps one of the most difficult decisions is whether to retreat a root-filled tooth that requires a crown and shows no evidence of a defective core or periapical disease but the root canal filling is technically deficient in some way (inappropriate filling material, root filling short). It is sometimes very difficult to judge how much improvement can be gained by retreatment when difficulties are expected in carrying out the treatment (e.g. negotiating a ledge).

Root Canal Retreatment

Root canal retreatment is often the preferred means of treating a failed root canal treatment, especially when the failure is due to a technical deficiency. The existing root filling is removed and the infected root canal disinfected using irrigants and medicaments. Root canal retreatment is often much more complicated than initial treatment as restorations may need to be dismantled in order to gain access to the canal system. It is important to assess that the tooth is restorable prior to embarking on prolonged and often expensive treatment. If the tooth is unrestorable then it should be extracted and a suitable replacement provided.

Root End Surgery

Surgery is normally reserved for cases in which apparently good quality root canal treatment or retreatment has been unsuccessful as the placement of a root end filling in a tooth with an infected root canal will undoubtedly lead to failure. A modern surgical approach is technically demanding and is probably best managed by a specialist.

Extraction

If a tooth is unrestorable or the prognosis for root canal retreatment is poor, extraction is the only option.

Over the years, fewer teeth have been placed in this category as the prognosis

for modern root canal retreatment has become clearer.

FACTORS THAT MAY HAVE AN AFFECT ON THE OUTCOME OF TREATMENT

The factors that may have an affect on the outcome of treatment include:

- Periapical radiolucency;
- Size of radiolucency;
- Technical difficulty of retreatment;
- Perforations.

Periapical Radiolucency

Evidence of periapical radiolucency around a failing root treatment indicates that the root canal system is infected. Elimination of bacteria from the root canal system is time-consuming and a thorough chemo-mechanical approach is required to eliminate these bacteria, along with an inter-appointment medicament.

Size of Periapical Radiolucency

There is no evidence to indicate that the size of a periapical radiolucency has an effect on outcome of treatment. Radiographically demonstrable apical periodontitis requires infection in the canal to initiate a host osteolytic response. The host response has not been correlated with extent of canal contamination by bacteria.

Where there has been long-term infection, bacteria may have become established on the external root surface. In such circumstances, root canal treatment alone is unlikely to resolve the condition, but is normally a first step before root end surgery.

Technical Difficulty

It is always worthwhile finding out where the previous root canal treatment was carried out. If an experienced practitioner or specialist has had difficulty gaining access to canals or instrumenting to length, will further attempts improve things?

Failure of root canal treatment as a

result of technical inadequacies is often an indication for root canal retreatment.

Types of Filling Material

Pastes usually offer the least resistance to removal. Some cements such as phenol resins are extremely difficult to remove. Single cone gutta-percha fillings are generally easier to remove than well compacted thermoplasticized fillings. Plastic Thermafil carriers can be removed relatively easily, but those with a metal carrier are much more difficult. Silver points are easier to remove when an extension has been left in the access cavity, but even then not all can be removed.

Fractured Instruments

Instruments that have fractured coronally are easier to remove than those positioned more apically. If the instrument is visible with good illumination and magnification then removal is probably more likely.

Nickel titanium instruments are more difficult to remove than stainless steel files as the material tends to shatter when ultrasound is used to vibrate the object. These cases are best managed by a specialist.

Perforations

Successful treatment of perforations depends on the ability to seal the defect and prevent infection; the size, position and time of perforation all affect successful treatment. The earlier a perforation can be repaired the better, and the possibility of infection must be kept to a minimum. Large perforations are most difficult to seal (>0.5 mm), and are associated with more tissue destruction. Location is probably of greatest importance. Close proximity to the gingival sulcus can lead to contamination by bacteria from the oral cavity. Perforations located below crestal bone have a better prognosis, as do those in the floor of the molar pulp chamber away from canal orifices. The introduction of Mineral Trioxide Aggregate (MTA) has improved the outcome of perforation repair.¹⁹

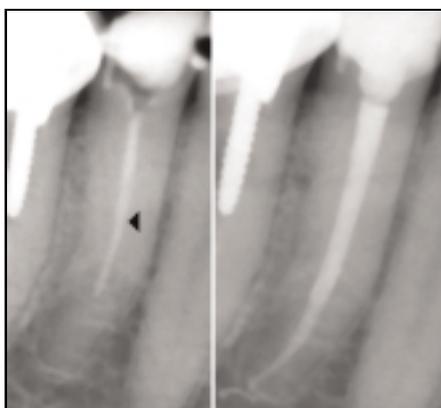


Figure 1. The mandibular premolar (arrowed) was retreated. The root canal was obturated to length using lateral condensation following thorough cleaning and medication for 1 week with calcium hydroxide.

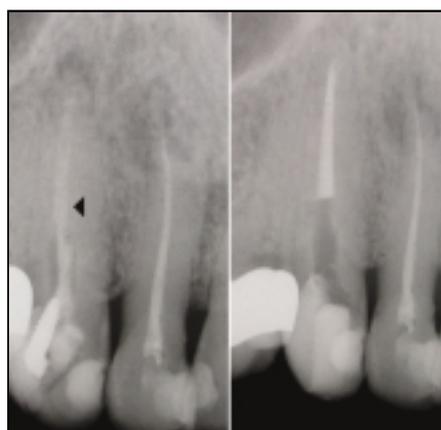


Figure 2. The single cone was easily removed from the maxillary canine (arrowed) and the canal reprepared and cleaned. A post hole was prepared following obturation.



Figure 3. Two further canals were located in this mandibular molar that had not been instrumented and therefore not cleaned with irrigants or medicament. All canals were filled to length.

TREATMENT PLANNING

Case 1

The mandibular first premolar was to be restored with a post crown and had been

causing some discomfort for the patient. The root filling was technically deficient; it was short of the apex, consisted of a single cone and the canal had been underprepared. It was quite likely that the root canal was infected, the coronal restoration was leaking and the canal had probably not been completely cleaned during primary root canal treatment.

Root canal retreatment should be feasible and offer a good prognosis. Surgery would not be the treatment of choice (Figure 1).

Case 2

This maxillary canine was causing some discomfort for the patient and it was intended to restore the tooth with a post crown. Radiologically, there were periapical radiolucencies associated with both the maxillary canine and lateral incisor. The root filling in the canine was technically deficient, and did not occlude the entire root canal system. Root canal retreatment would have a good prognosis, to save the tooth (Figure 2).

Case 3

The patient presented complaining of discomfort associated with the mandibular second molar. The tooth was tender to bite on and there was a sinus tract present in the buccal sulcus. Radiographically, there was a periapical radiolucency. It was planned to place a crown on the tooth.

The existing root canal treatment was completed over 5 years previously. There were technical deficiencies in the root canal treatment that had been carried out: the filling material was short in both the canals that had been obturated and it was likely that at least one canal had not been prepared and cleaned.

As the root canal system had been incompletely cleaned and was undoubtedly infected, root canal retreatment was considered the treatment of choice, with a good prognosis. A surgical approach would not be considered appropriate (Figure 3).

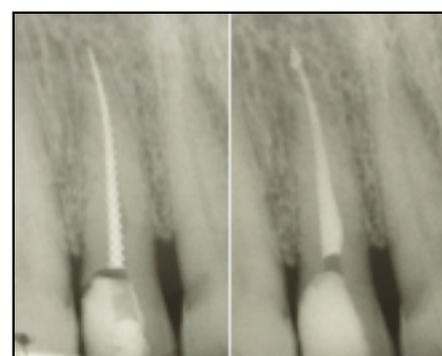


Figure 4. The Profile was removed using a Masserann trephine and the root canal treatment completed.

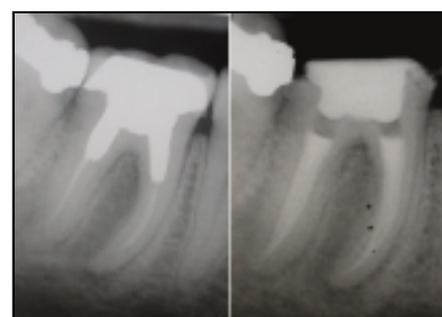


Figure 5. The amalgam core was removed very carefully using ultrasonic tips under the microscope and two uninstrumented canals located and treated.

Case 4

Removal of an instrument in the coronal aspect of the root canal should be quite feasible allowing the root canal system to be thoroughly disinfected. In this case, a Profile had fractured in the access cavity. Retrieval of the instrument and completion of the root canal treatment should be achievable (Figure 4).

Case 5

The mandibular molar tooth, which had been restored with a Nayyar core, was symptomatic. Root canal retreatment would be taxing as the restorative material would be difficult to remove from the coronal part of the root canal system without risking perforation. Specialist ultrasonic tips were required to retreat this case (Figure 5).

Case 6

A small piece of fractured instrument in

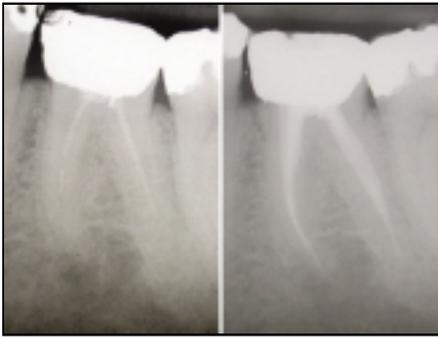


Figure 6. It was not possible to remove the small piece of file, but the canals were negotiated to the apex and the fragment bypassed allowing thorough cleaning of the canal system prior to filling.



Figure 7. It would not be possible to visualize the small fragments of file in the mesial root, even under high magnification using the surgical microscope. Preparation and cleaning would be carried out to the most apical extent possible.

the mid third of the canal would be challenging to remove. In this case, however, it should be possible to bypass the fragment in the mesial canals of the mandibular molar and

effectively disinfect the root canal system (Figure 6).

Case 7

Removing a fractured instrument from the apical region of a root canal is extremely difficult. In this case, it is unlikely that it would be possible to remove the fractured files. Therefore, root canals should be cleaned and obturated to the most apical extent possible. A surgical approach, which would require specialist expertise, could then be considered if symptoms persisted (Figure 7).

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Congratulations to Linda Shaw OBE

The members of the Editorial Board and all staff of *Dental Update* would like to congratulate Linda Shaw on her achievement in the New Year's Honours List.

Sadly, Linda retired from the Editorial Board of *Dental Update* in 2003, having been an enthusiastic and valuable member since 1992. Everyone associated with *Dental Update* wish Linda and her husband Jeremy well in their retirement.

