The implications of coronal leakage in endodontically treated teeth

Dr Raphael Bellamy explains the clinical and biological implications of coronal leakage in endodontically treated teeth and proposes some simple solutions to maximise success

Raphael Bellamy BDS (NUI) Cert. Endo. is a graduate of University College Cork and The Goldman School of Dental Medicine in Boston, Massachusetts, where he completed his postgraduate studies in endodontics. He is currently in private practice limited to endodontics in Dublin

Pulpal and periradicular diseases develop when micro-organisms and their by-products contaminate these tissues. Therefore, a major goal of both preventive and restorative dentistry is to prevent the penetration of micro-organisms into the coronal pulp space and the root canal system.

The root canal system, once invaded, may harbour many species of micro-organisms, their antigenic by-products and variable amounts of inflamed and necrotic tissues.

We have discussed, in previous articles, the mechanical and biological objectives of root canal therapy so this allows us to carry out the procedure in a predictable manner. However, simply said, our goal must be to:

1. Remove irritants from the root canal system
2. Obturate the cleaned and shaped system
3. Prevent future contamination of that system.

It has been customary in these islands to leave root-treated teeth for at least six months before placing a definitive restoration on the tooth. That is what I was taught in the early 1970s and I dare say that this teaching was passed down through the 40s, 50s and 60s. Now it is accepted and common practice for root-treated teeth to be restored definitively immediately following root canal therapy. What happened? What changed? The root canals didn't get easier, straighter and less infected in the last 50 years. But there has been a marked acceleration in the study and development of endodontic rationale and treatment. This has led to a firm belief that endodontic treatment is a sound basis for the resurrection of a diseased tooth back to health, and that all teeth with pulpal disease can be saved if periodontally sound or can be made so. I have preached on enough about belief in endodontic treatment in previous articles. So I now assume that we are all believers! Remember, endodontic success=100%-X (where X is the operator).

Even well-filled root canals can become recontaminated. This can occur when:

1. There has been a delay in the restoration of the tooth following root canal therapy
2. The coronal temporary filling, placed at the time of root canal treatment, is compromised
3. The tooth is fractured and the canal system is exposed prior to final restoration
4. The final restoration, regardless of type or design, lacks ideal marginal integrity or cannot withstand the forces of occlusal function
5. Recurrent decay is present at the restoration margins.

In vitro and in vivo studies show that post-endodontic coronal leakage can allow bacterial penetration into the root canal system. This results in recontamination and failure of the treatment. A major concern is the speed at which the entire root canal system becomes contaminated. Some report as little as 20 days.

How long is too long?

When to retreat is the question that continues to plague dentists. No conclusive timeline has been determined for the recontamination of the complete root canal system. Time alone is not the issue. The basic tenets of root canal therapy must still hold true, i.e. thorough cleaning, shaping and obturation are equally important factors. Naturally, the passage of microbes along a system will be facilitated by the presence of tissue remnants in that system or the existence of significant voids in an underfilled canal with an inadequate seal. What happens when a temporary crown is lost, exposing a 5mm seal of gutta percha to the hostile elements of the oral cavity? Studies have shown that bacteria can contaminate a whole root canal system in 20 to 60 days. What happens when a temporised endodontically treated tooth has to remain unrestored yet functioning for six months or more before definitive restorative work is to be completed? What happens when post impressions are taken after 30 minutes of Duralay build-up and the patient is free to open and close at will while you busy yourself with more important matters like the accuracy of the impression? We should never lose sight of the fact that we are dealing with the elimination of bacteria from the root canal system.

Preventing coronal leakage

Believe it or not, this begins at the access cavity. How can Schilder or Ruddle speak with enthusiasm for two hours on the subject of an access cavity? Because it is the key to success. But there are several other opportunities to prevent

coronal leakage:
1. Pre-endodontic tooth preparation
2. Thoroughness of root canal obturation
3. Temporary seal of the RCS during and after treatment
4. Choice and integrity of the final restoration
5. Timeliness in restoration and the establishment of atraumatic occlusion
6. Long-term follow-up to evaluate the integrity of the definitive treatment.

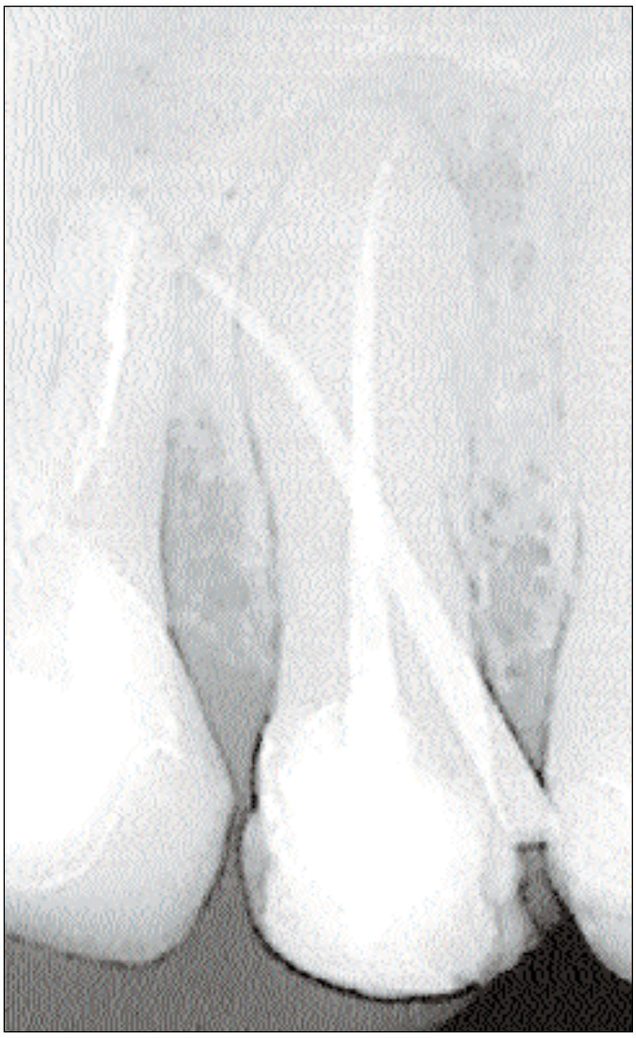
Pre-endodontic tooth preparation

Complete removal of caries and defective restorations and establish sound tooth margins above the gingival tissues for both rubber dam placement and the ultimate restoration. Close examination of the coronal structure for any cracks or fractures that will allow bacterial ingress during treatment. The placement of rubber dam for endodontics is mandatory. Incredibly, this is still not common practice in general dentistry. The placement of rubber dam is taught in all dental schools and whatever the method of application, the practice appears to be dismissed immediately after dental training because of its complexity in application. In reality, the complete isolation of a tooth for endodontic treatment should take no more than 30 seconds. Do it. Not for the purpose of dental protection, but for the purpose of keeping bacteria out, which is the key to endodontic success.

Thoroughness of the root canal cleaning, shaping and obturation techniques

A perfect seal of the root canal system is desirable, but contemporary materials and techniques available for obturation do not always support this physical or biological achievement.

Presently, it is impossible to completely hermetically seal the root canal system. Invariably there will be residual bacteria but these will not be in great enough numbers so as to promote pathology or symptoms. On the contrary, healing will be immediately promoted on the reduction of the bacterial flora and the balance of power shift in favour of the host. Three-dimensional obturation is essential, while improper sealant use, and short and incomplete obturation will inevitably lead to failure. In this regard it is my opinion that the technique of cold lateral condensation has no place in modern endodontics because it cannot hope to address the filling of the root canal system in three dimensions. I will write on this subject at a later date.



Satisfactory endodontics and failure due to coronal leakage

Temporary seal of the root canal system during and after treatment

A faulty temporary filling, during or after root canal therapy, is one of the major causes of coronal leakage. Failure of the temporary material is usually due to the lack of thickness of the material, improper placement of the material and failure to evaluate the occlusion after placement.

Commonly used temporary filling materials are Cavit, Term and IRM. After placement of a cotton pellet in the chamber, the material should be placed incrementally with no gaps or voids. A depth of at least 4-5mm is indicated. The cotton ought to be placed as a minimum so as not to lift or dislodge the temporary material. Based on current evidence, this seal can be expected to remain effective no longer than three weeks. Allowing the temporary material to remain longer than this period is an invitation to coronal leakage and future failure. In the past it was customary to leave the tooth dressed temporarily after root canal therapy to 'see how they got on'. This was a recipe for disaster and the treated teeth were doomed to fail due to microbial leakage.

When endodontic treatment is proposed as a therapy, the clinician is duty bound to discuss the definitive restoration, no matter how financially distasteful that may be. There is absolutely no point in carrying out root canal therapy on molar or premolar teeth that are in functioning occlusion unless these are restored with full cuspal protection in mind, e.g. full crown, onlay.

Evidence suggests that up to 25% of endodontically treated posterior teeth will fracture over five years, resulting in the loss of the tooth. What a waste of time and effort. So commitment to salvage the tooth must be total from the dentist and the patient.

Single or multiple endodontic visits?

When a dentist places a temporary dressing during multiple appointment endodontic treatment, then an intracanal medicament ought to be used. Evidence suggests that the medicament of choice is calcium hydroxide.

The question of multiple appointment endodontics or single-visit endodontics is also high up on the list of questions that continue to plague dentists.

Of course endodontics is a time consuming business and there are times when the clinician is physically, mentally or logistically

unable to deal with a case any longer. In this instance it is better for all concerned to reschedule. Sometimes the tooth is actively discharging through the foramen and it is not prudent to attempt to seal the system although it is cleaned and shaped. However, in my experience, notwithstanding the above conditions, I find that every time I re-enter a tooth it takes time to get back 'in to the tooth' mentally. (I have spoken before on the subject of mental acuity.) This can lead to over-instrumentation of the canal, resulting in violation of the mechanical objectives. One ought to reflect on the fact that there are not many dentists that carry out multiple-visit extractions!

Remember what we are trying to do here; the elimination of the root canal system as if we had extracted the tooth. That is what will give us the best chance of success.

Choice and integrity of the final tooth restoration

Not all endodontically treated teeth need rebuilding, i.e. post and core, followed by crown placement. The routine use of post and core in anterior teeth following root canal therapy is discouraged, unless there is gross loss of coronal tooth structure.

Contemporary research has shown that anterior teeth restored with bonded composites in the lingual access openings are not only stronger than those with posts, cores and crowns, but also have minimal coronal leakage.

When using a core build-up in anterior or posterior, the interface of the core material and the tooth structure ought to be in a position at least 2mm above the free gingival margin to allow for placement of the crown on at least 2mm of sound tooth structure – the ferrule effect. The margin of the crown must not violate the biological width.

Increasingly, in my practice, I will place or bond core filling material at the level of the pulp floor to the entrance of the access cavity. This eliminates the necessity of the referring dentist entering the tooth again and they are happy not to do so.

In conclusion, the restoration of an endodontically treated tooth should commence as soon as possible after root canal treatment. Delaying definitive restoration allows teeth with a periapical radiolucency to demonstrate healing prior to restoration; however, this action is unnecessary with today's advancements in root canal therapy. Believe!

I would draw your attention to an article by Ray and Trope in 1995 (reference provided) indicating that in their studies a poorly treated root canal tooth, if restored well, has a better long-term success rate than a well root-treated tooth with a poor definitive restoration.

Satisfactory endodontics and failure due to coronal leakage

Long-term follow-up

Follow-up evaluation of all endodontic and subsequent restorative procedures is essential because of coronal leakage and its impact over time. This process involves evaluation of signs such as symptoms, radiographic indicators of pathosis and examination for the evidence of coronal leakage such as recurrent decay or loss of marginal integrity.

Further reading

Beckham B M, Anderson R W, Morris C F (1993) An evaluation of three materials as barriers to coronal microleakage in endodontically treated teeth. *J. Endo* 19: 388-391

Diaz-Arnold A M, Wilcox L R (1990) Restoration of endodontically treated anterior teeth: an evaluation of coronal microleakage of glass ionomer and composite resin material. *J Pros. Dent*. 64: 643-646

Madison S, Swanson K, Chiles S A (1987) An evaluation of coronal micro leakage in endodontically treated teeth. Part II. Sealer Types *J. Endo.* 13: 109-112

Madison S, Wilcox LR (1988) An evaluation of coronal micro leakage in endodontically treated teeth. Part III. In vivo study *J. Endo*. 14: 455-458

Ray H A, Trope M (1995) Periapical status of endodontically treated teeth in relation to the technical quality of the root filling and coronal restoration. *Int. Endo. J.* 28: 12-18

Saunders W P, Saunders E M (1994) Coronal leakage as a cause of failure in root canal therapy: a review. *Endodontics and Dental Traum.* 10: 105-108

Acknowledgements

All images provided for this article are digital and captured with a Trophy RVG system, Trophy Radiologie SA, France

You can contact Dr Bellamy via email at RBel5553@aol.com