Cleaning is key

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Completely disinfecting the canal system is challenging when all factors are considered. If we are looking at the nano level there are approximately 76,000 dentinal tubules per square millimetre of dentine. Each of which can harbour a colony of bacteria. Then there may be inaccessible anatomy such as lateral canals, apical deltas or fins. These are factors that need considering outside of canal curvatures that may or may not be entirely visible in the plane of the radiograph. It is clear that outside of the contact our files make with the walls of the root canal there needs to be chemical disinfection to further reduce bacterial load. Irrigants disinfect as well as lubricate instruments and they dissolve the pulp. Sodium hypochlorite has been the mainstay irrigant for decades.

During the 1980s, Bystrom and colleagues investigated the effect of mechanical instrumentation with and without adjunctive use of hypochlorite. They found, unsurprisingly so, that when compared to pure mechanical instrumentation, the use of hypochlorite in combination with hand filing significantly reduced bacterial load. As such chemomechanical instrumentation was shown to be crucial for endodontic success. They compared irrigation with saline, 0.5% and 5% hypochlorite over a sequence of 5 appointments. Interestingly they found no difference in the reduction of bacterial load between 0.5 and 5% hypochlorite. Despite what was likely to be a comprehensive protocol for these teeth, 7 of the 15 specimens in this study still had bacteria that they could grow at the end of treatment. The presence of cultivable bacteria does not necessarily mean we have failure—it merely means that there may be a cohort of bacteria that have resisted treatment. Mechanical instrumentation does reduce bacterial load by itself—this is by way of physical removal of tissues where bacteria reside, while also facilitating the dispersal of the irrigant into the canal. Siquiera and colleagues found that enlarging the canal from size 30 to 40 resulted in a significant decrease in endodontic pathogens.

It seems that irrigation and instrumentation are both highly inter-related in canal disinfection. Take washing your car for instance, purely covering it with soapy water and rinsing won’t remove the motorway bugs and bird produced projectiles. A good scrubbing with a sponge is needed, or if you are really serious about cleaning, a pressure washer! This begs a further question—how would your patients feel if they knew that, more or less, the same or very similar liquid they use to clean bathroom suites is the same that we use to clean the inside of their teeth? On recent evidence of a dentist to the “stars” appearance on national TV not much—he advocated using charcoal to whiten teeth, which you may be able to buy from your local petrol station for barbecues.

Hypochlorite is an effective bactericidal but does not remove the smear layer. The smear layer is a mix of organic material (protein, pulp remnants, saliva, microorganisms) with an inorganic components consisting of minerals from the dentine. The smear layer prevents bacteria residing in the dentinal tubules from being exposed to the irritant as well as reducing the contact between the dentine and sealant during obturation. Hence, utilising EDTA to remove the smear layer prior to obturation but after completion of preparation and instrumentation is sensible. A penultimate rinse with EDTA then a final rinse with hypochlorite prior to drying has been advocated heavily in the literature.

Bacteria and the biofilms

Unlike what we once thought, bacteria do not tend to just sit alone and remote from each other. If only they were this antisocial and could be picked off one by one! Bacteria join forces and create symbiotic groups, share resources and protect each other from external influence. This is commonly known as a “bio-
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film", which has a thin but robust layer of muccal that adheres to a solid surface housing the community of microorganisms. They not only share resources, they also share information that promote each other’s survival through RNA or DNA. As the majority of bacteria will be encapsulated in this layer, purely irrigating without disrupting this layer is inefficient. The word disrupting is a bit kind really—it needs to be destroyed to reveal all its contents and expose it to the bleach for chemical action. It is the methods of disruption of the canal biofilm that has seen a lot of development over the last 10 years or so. Much in the same way a pressure washer can clean that more quickly and efficiently than a sponge, energising the disinfectant results in improved cleanliness.

**Energising the irrigant**

This can take many forms. The simple and straightforward form ensures appropriate exchange of the fluid and displacement into the recesses where airlocks may reside. This can be achieved through applying a GP point into the prepared canal to displace and disperse.

Ultrasonic irrigation transmits energy by an oscillating instrument. This results in two different phenomena. Cavitation is the growth and subsequent collapse of small gas bubbles due to a drop in pressure. Acoustic streaming is the bulk movement of fluid when pressure waves are projected, resulting in vortex motion around a fast moving oscillating instrument. This results in shear stresses to tear the biofilm apart.

**Keeping the canal clean**

Once irrigated and prepared, the clinician has a choice—to obturate or to dress. Some may argue that the canal is cleanest at the end of instrumentation and that for convenience, obturating in a one visit arrangement is the best option. As we know, not all bacteria are removed or killed during treatment. Dressing the canal with calcium hydroxide may continue the process of eradication of the residual microorganisms over a 2-week period. The choice between the two schemes sometimes boils down to the presenting factors of the case. Where a tooth is difficult to instrument, has a large lesion or is quite obviously chronically infected with a history of pain, then dressing may be more of a consideration. If a tooth is treated in a de novo manner and treatment goals are achieved with no history of pain then a single visit treatment could be utilised.

The goal of obturation is to seal the canal system to prevent any reinfection and entomb any bacteria not eradicated by chemomechanical debridement. If the obturation is through the apex, this can have significant implications. GP through the apex can carry bacteria outwith of the canal and exacerbate symptoms. A foreign body reaction could also develop.

We also have to remember that a beautiful obturation of a canal achieved without rubber dam and utilising saline or local anaesthetic irrigation is substandard treatment. It can be difficult to assess the “quality” of treatment when a radiograph of a “failed” tooth is examined in this context. Indeed, an obturation that is short of the radiographic apex having been treated under rubber dam and with copious amounts of irrigation is more likely to be successful than the previous scenario. Attributing too much significance to the radiographic appearance of the obturation is short-sighted. Indeed, Katebzadeh and colleagues in the late ’90s witnessed healing in the absence of obturation where teeth where instrumented and irrigated optimally under isolation. SEALants are also antibacterial and aide filling the voids between the GP and the canal system. One further option would be to provide a sub-seal to each of the canal orifices. This can be achieved by removal of 1 mm of GP and packing a good thick mix of IRM packed with a plunger.

**Covering the cusps**

The provision of a coronal restoration (if provided optimally) can improve the coronal seal while also structurally protecting the underlying tooth tissue. Due to endodontic treatment, resulting in reduction of tissue bulk and stiffness the risk of fracture increases. Where both mesial and distal margins have not been breached and the access cavity is confined to the occlusal surface, a crown restoration may not be required. Once a margin is breached the tooth is more likely to flex and result in cracks or fractures. Commonly asked question, “When should the crown be provided? Soon after the root canal treatment or when the treatment has proven to be successful?” If the success of endodontic treatment is significantly in doubt then this should be communicated to the patient and a well compacted direct restoration may be the best option, otherwise an onlay or if tooth tissue is significantly reduced, a crown should be provided soon after completion.

**Conclusion**

Bacteria are public enemy number one in dentistry. Disinfesting the root canal system by irrigating in combination with mechanical instrumentation is key to success in root canal therapy. Preventing further re-infection or persistence of residual bacteria after the formal stages of treatment through dressing initially and a quality coronal seal subsequently is as important as the root canal therapy.