Endodontic retreatment

Achieving success the second time around

Root-canal treatment has been shown to have a success rate of 92%. However, as research methodologies move towards higher levels of substantiation, clinicians must rely on the best current evidence available to gain insight into the expected outcomes of their treatment. The highest level and best current evidence we have on the clinical success of endodontic treatment comes from a meta-analysis of the literature.

A meta-analysis done in 2007 by Ng et al provides a thorough review of endodontic success rates from a variety of sources. They found a weighted pooled success rate of 68 to 85%, with at least one year of follow-up. The success rate of retreatment was shown to be 83% versus 71.8% for endodontic surgery after four to six years.1

The presence of apical periodontitis is one factor that has been shown to decrease the success rate. Without apical periodontitis, a ten-year success rate of 92% to 98% has been shown for both initial and retreatment root-canal therapy. With the preparative presence of apical periodontitis, there is a decrease in the success rate from 74% to 86% over the ten years. From this, it is evident that endodontic healing is attainable through retreatment procedures, allowing us to maintain our patients’ natural teeth (Figures 1a–c). Although the alternative clinical treatment option of implant placement can provide an effective option for replacing a missing tooth, healthy maintenance of the natural tooth should remain the overall goal.

Post-treatment disease is, inevitably, a result of the bacteria and the host response to the infection. These microorganisms are the most critical aetiology of post-treatment disease, as they are present within the root-canal system of a previously endodontically treated tooth owing to a combination of substandard endodontic techniques, iatrogenic treatment issues and restorative failure.

Intra-radicular bacteria are the primary aetiology of post-treatment disease2 and eradication of these bacteria is the primary goal of retreatment procedures. The intra-radicular bacteria present in the previously treated tooth are persistent and resistant methods. Bacteria can hide and survive in canal ramifications, deltas, irregularities (flaps) and dentinal tubules.3

Figure 2 shows the complex root-canal anatomy preoperatively (green areas) and the minimal amount of canal-wall cleansing that was accomplished during canal instrumentation (red areas). The remaining green area illustrates the space that might be left untreated, thereby providing a source of bacteria and supporting substrates for intra-canal infection. The potential substrates that are found inside the canal and help the bacteria survive can include untreated pulp tissue, the presence of a biofilm and tissue fluid. This may be present in the canal owing to a poor coronal or radiographic seal and microfissure formation. The presence of a poor seal, bacteria and substrate for their growth results in ideal conditions for persistent inflammation and disease.4

The bacteria present in the initial infection of a root canal differ markedly from the bacteria infecting a previously treated tooth. Prettreatment flora is polymicrobial with equal numbers of Gram-negative and -positive bacteria. Post-treatment bacteria are predominantly Gram-positive5 and they have been shown to be able to survive in harsh environments and to be resistant to many treatment methods.

There are high numbers of Enterococcus species,6 Enterococcus faecalis, for example, has been shown to be a common isolate in 27 to 77% of teeth with post-treatment disease.7 A contaminated canal space may result from incomplete cleansing initially or subsequent leakage into root-canal spaces following root-canal treatment. Once present inside the canals, E. faecalis has a variety of characteristics that allow it to evade our best efforts to eradicate it from the root-canal system, including the ability to invade dentinal tubules and adhere to collagen.8 It is also resistant to calcium hydroxide application inside the canal system, which is an inter-appointment treatment technique used to help remove microorganisms and their by-products, such as lipopolysaccharides, from the canal space.9,10 E. faecalis’s resistance to calcium hydroxide action arises from its ability to pump hydrogen ions from a proton pump. The hydrogen combines with the hydroxyl ions of calcium hydroxide and neutralises the high pH value.11

E. faecalis is also able to resist calcium hydroxide by being part of a biofilm. The protection of bacteria within a biofilm matrix prevents the contact of the bacteria with irrigants and medicaments, and allows communication between bacteria to aid in survival capabilities.12 The presence of E. faecalis is well documented, however, its role in post-treatment disease has yet to be proven definitively.13 In survival mechanisms, however, shine a light on the persistent capabilities of these bacteria, and our clinical techniques must be focused on the challenge of eliminating them.

Iatrogenic issues encountered during the initial root-canal treatment may be the cause of intra-canal bacterial infection. These issues may include instrumentation, cleaning and shaping, inadequate canal enlargement, missed canals, lodging, canal transportation, over-instrumentation, and the use of the canal by debris or separation of instruments. Failure to use or use too small a volume of an appropriate irrigant solution, such as sodium hypochlorite, is an iatrogenic error.

Full-strength 6% sodium hypochlorite has been shown to be highly antimicrobial and able to dissolve tissue and disrupt bacterial biofilms.13,14 These qualities in an irrigant are ideal for the debondment of residual bacterial tissue and debris. The use of a rubber dam to isolate the treatment field is the standard of care for endodontic treatment. Failure to use a rubber dam

Fig 1a

Fig 1b

Fig 1c

Fig 2
Restorative failure is a common cause of post-treatment disease. The following case illustrates the ability to overcome basic incomplete treatment to achieve successful healing (Figs 3a–c).

**Clinical example**

Restorative failure is a common cause of post-treatment disease. Failure to place an effective permanent access restoration in a timely manner can allow for bacterial entry into the root-canal system by coronal leakage. Submarginal leakage on a crowned tooth can also allow bacterial entry to occur.

Decay in a previously treated tooth is another source of bacterial contamination. Structural damage to a tooth by trauma, cracking or fracture may provide an entry point for bacterial contamination of the canals. Our patients are responsible for their own oral health and must commit to effective oral hygiene techniques. Failure of the patient to perform effective oral hygiene can result in the failure of even the most well-executed root-canal and restorative treatments.

With the bacterial challenges clinicians have to face, retreatment techniques must be capable of effective elimination of bacteria and their substrates. The use of a dental operating microscope and ultrasonic instruments allows clinicians to uncover all existing canal anatomy properly to ensure that they are able to clean the root-canal system completely. The following clinical case (Figs 4a & b) illustrates the extent of the canal space left unstircted in the initial root-canal therapy by not opening the mesiobuccal canal adequately and not locating and cleansing the hidden second mesiobuccal canal.

Endodontic ultrasonic tips are highly efficient at removing core buildup material, paste fills, posts and silver-point fillings, as demonstrated in Figure 5. These instruments allow clinicians to conserve root dentine by providing excellent visibility under a dental operating microscope, thereby greatly improving the ability to retreat canals (Figs 6a–c). A heat source such as a System B tip (Xaxis, SybronEndo) is efficient for the removal of gutta-percha and resin materials from the coronal third. Hand and rotary files can remove root fillings and shape canals to appropriate working lengths. Current NiTi rotary files are highly flexible and resistant to separation and allow us to mechanically enlarge the apical third of root canals safely and efficiently without alteration of the natural canal morphology, which allows effective irrigation to reach the complex apical root-canal anatomy where bacteria are able to hide and resist debridement.

Once the canals have been located and instrumented, the ability to irrigate is mandatory. Effective irrigation is essential to success of endodontic treatment. The irrigant solutions target the bacteria we are trying to eliminate. While sodium hypochlorite is often used as an effective smear layer removal agent,24 therefore, mechanical debridement and canal instrumentation provide a pathway for copious chemical irrigation deep into the canal.

Passive ultrasonic irrigation allows clinicians to place an irrigant solution into the pulp chamber and activate it as it is carried down to the apex of the root canal. The IrriSafe tip from Satelec (Acetom, Fig 7) is a non-cutting ultrasonic file that is placed into each canal and is moved up and down in the canal for three cycles of 20 seconds. Passive ultrasonic irrigation has been shown to irrigate lateral canals better at 4.5 and 2 mm from the working length of canals as compared with needle irrigation alone.25 It has been demonstrated that passive ultrasonic irrigation can remove dense debris in a canal up to 3 mm in front of where the tip extends apically in straight or curved canals.26 This evidence shows that an effective flow of irrigation can assist in the cleansing of teeth in which canal alternation occurred during the initial root-canal treatment.

The following silver-point case (Figs 8a–c), with a large distal post and apical transportation in the mesial root, demonstrates the successful healing of post-treatment disease when proper disinfection has been accomplished. This case illustrates the reason that retreatment is the primary treatment option for post-treatment disease.

Endodontic retreatment should be the primary treatment option for post-treatment disease. Once debridement and disinfection have been completed, appropriate obturation methods are used to seal the canal spaces. The warm vertical technique using gutta-percha or resin with an appropriate sealing agent provides a thorough seal of the well-cleaned and shaped canal spaces. The final restoration must provide a proper seal of the pulp chamber to prevent coronal micro-leakage.

Current evidence has demonstrated that we can retreat previously endodontically treated teeth properly and successfully. The literature has also shown that specific bacteria, such as *E. faecalis*, are able to survive inside a previously filled canal. The use of a dental operating microscope, ultrasonic instruments, irritants, rotary NiTi files and appropriate obturation materials increases our ability to attain healing after retreatment. As we continue to strive to maintain healthy teeth for our patients, endodontic retreatment should be the primary option for patients with post-treatment disease.

A complete list of references is available from the publisher.