Endodontic irrigants and irrigant delivery systems

By Gary Glassman, Canada

Endodontic treatment is a predictable procedure with high success rates. Success depends on a number of factors, including appropriate instrumentation, successful irrigation and decontamination of the root canal space to the apices and in areas such as root canals. This process must be followed by complete obturation of the root canals, and placement of a coronal seal prior to restorative treatment. Several irrigants and irrigation delivery systems are available, all of which behave differently and have relative advantages and disadvantages. Common root-canal irrigants include sodium hypochlorite (NaOCl), chlorhexidine gluconate, alcohol, hydrogen peroxide and ethylenediaminetetraacetic acid (EDTA). In selecting an irrigant and technique, consideration must be given to their efficacy and safety. With the introduction of modern techniques, success rates of up to 98 percent are being achieved. The ultimate goal of endodontic treatment per se is the prevention or treatment of apical periodontitis, such that there is complete healing and an absence of infection, while the overall long-term goal is the placement of a definitive, clinically successful restoration and preservation of the tooth. For these to be achieved, appropriate instrumentation, irrigation, decontamination and root-canal obturation must occur, as well as attainment of a coronal seal. There is evidence that apical periodontitis is a biofilm-influenced disease. A biofilm is an aggregate of microorganisms in which cells adhere to each other and/or to a surface. These adherent cells are frequently embedded within a self-produced matrix of extracellular polysaccharide substance. The presence of microorganisms embedded in a biofilm and growing in the root-canal system is a key factor for the development of periodontal lesions. Adjunctively, the root-canal system has a complex anatomy that consists of arborizations, collateral and mesial-decants that harbor organic tissue and bacterial contaminants (Figs. 1a, b).

The challenge for successful endodontic treatment is always been the removal of vital and necrotic remnants of pulp tissue, biofilm biofilm and in situ, instrumentation, the dentin smear layer, microorganisms, and micro-toxins from the root-canal system. Even with the use of rotary instrumentation, the nickel-titanium instruments currently available only allow only the central body of the root canal to be reached in a reliance on irrigation to clean beyond what may be achieved by these instruments. In addition, Enterococcus faecalis and Actinomyces prevention of smear layer removal can only be achieved by agents such as NaOCl and EDTA — penetrate deep into dentinal tubules, making their removal through a biological instrumentation impossible. Finally, E. faecalis commonly expresses multidrug resistance, complicating treatment. Therefore, a suitable irrigant and delivery system are essential for efficient irrigation and the success of endodontic treatment.

The desired attributes of a root-canal irrigant must not only be effective for dissolution of the organic of the dentinal matrix, but also be effective in deep into the dentinal tubules, biocompatibility and lack of toxicity, the ability to dissolve organic material and remove the smear layer, ease of use, and cost.

As mentioned above, root-canaI irrigants currently in use include sodium hypochlorite, NaOCl, EDTA, alcohol and chlorhexidine gluconate. Chlorhexidine gluconate is a wide antimicrobial agent, the main bacteria associated with endodontic infections (E. faecalis and A. israelii) are sensitive to it, and it is biocompatible, with no tissue toxicity to the periapical or surrounding tissue. Chlorhexidine gluconate, however, lacks the ability to dissolve necrotic tissue, which limits its usefulness. Hydrogen peroxide as a root-canal irrigant helps to increase the physical act of irrigation, as well as through efferveescing of the solution. However, while an effective anti-bacterial irrigant, hydrogen peroxide does not dissolve necrotic tissue and exhibits toxicity to the surrounding tissue. Cases of tissue damage and facial nerve damage have been reported following use of hydrogen peroxide as a root-canal irrigant. Alcohol-based canal irrigants have antimicrobial activity too, but they do not dissolve necrotic tissue. The irrigant that satisfies most of the requirements for a root-canal irrigant is NaOCl. It has the unique ability to dissolve, depending on the organic components of the smear layer, and it also kills sessile endodontic pathogens that persist in a biofilm. There is no other root-canal irrigant that can meet all these requirements, even with the use of methods such as lowering the pH, increasing the temperature or adding surfactants and gels to increase the wettability of the irrigant. However, although NaOCl appears to be the most desirable single endodontic irrigant, it cannot dissolve inorganic dentine particles and thus cannot prevent the formation of a smears layer during instrumentation.

Calcifications hindering mechanical preparation are frequently encountered and can impair the root-canal system, further complicating treatment. Denineralizing agents such as EDTA have therefore been recommended as adjuvants in root-canal therapy. Thus, the combination of NaOCl and EDTA has been used worldwide for antimicrobial root-canal irrigation. The combination of NaOCl and EDTA has been used world-wide for antimicrobes of root-canal system irrigation. The combination of NaOCl and EDTA has been used worldwide for antimicrobes of root-canal irrigation. The combination of NaOCl and EDTA has been used world-wide for antimicrobes of root-canal irrigation. The combination of NaOCl and EDTA has been used world-wide for antimicrobes of root-canal irrigation.
The plastic rotary F File. Although sonic or ultrasonic instrumentation is more effective at removing residual canal debris than rotary endodontic files are, and irrigation solutions are often delivered to the canal during this endodontic treatment, many clinicians still do not incorporate it into their endodontic instrument armamentarium. The common reasons given for not using sonic or ultrasonic endodontic equipment are: continuing to set up, an unwillingness to incur the cost of the appliance, lack of awareness of the benefits of this final instrumentation step in endodontic treatment. It is for these reasons that an endodontic polymer-based rotary tip was developed. This new, single-use, plastic rotary file has a unique file design with a diamond abrasive embedded into a non-toxic polymer. The F File will remove dentinal wall debri and agitate the NaOCl without enlarging the canal further.

Pressure-alternation devices

Rinesmo irrigates the canal by using pressure-alternation technology. Its components are a handpiece, a cannula with a 7 mm working length (WL) endodontic file carrying the irrigant. The handpiece is powered by a dental air-powder system at a delivery speed of 0.6 ml per minute. Research has shown that it has become the gold standard of the root-canal system, but more research is required to provide scientific evidence of its efficacy. Periapical extrusion of irrigant has been reported with this device.

The EndoVac apical negative-pressure system

The EndoVac apical negative-pressure irrigation system has three components: the Master Delivery Tip, Macrocannula and Microcannula. The Master Delivery Tip is connected to a syringe and evacuates the irrigant (Fig. 2). The Microcannula is used to suction irrigant from the chamber to the coronal and middle segments of the canal. The Macrocannula or Microcannula is connected via tubing to the high-speed suction of a dental unit. The Master Delivery Tip is connected to a syringe of irrigant and the evacuation of irrigant is connected via tubing to the high-speed suction of a dental unit. The plastic Macrocannula is an end of ISO size 0.55 mm in diameter.
This does not imply that NaOCl can or should be excluded as an endodontic irrigant; in fact, its use is critical, as has been discussed previously. In this study, this does imply that it must be de-

served safely.

Safety first

In order to compare the safety of six-extrusion irrigation, an in-vitro test was conducted using the working length of the apical negative pressure of irrigation with NaOCl on vital tissue are well
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which could create the risk of a NaOCl CI incident. The manufacturer’s instructions must be followed for usage of the Master

duty Tip.

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