Endodontic Irrigants 101

by David Carter, DMD

All of us were taught to irrigate endodontic cases in dental school; however, where and when we went to dental school likely shaped our irrigation protocols. If you discuss the methods of irrigation with practicing dentists, you will find a diverse set of irrigants being used in a multitude of different ways. It is my hope that after reading this article, you will have a better perspective on the reasoning behind the use of certain irrigants, benefits and drawbacks of different solutions and an awareness of some of the clinical adjuncts available to assist in irrigating the root canal system.

"One of the primary reasons for irrigating the root canal system is to ensure cleanliness of the canals prior to obturation. This cleanliness involves both elimination of microorganisms and removal of organic matter."

Irrigation has been performed in conjunction with endodontic therapy for many years. One of the primary reasons for irrigating the root canal system is to ensure cleanliness of the canals prior to obturation. This cleanliness involves both elimination of microorganisms and removal of organic matter. To this end, sodium hypochlorite has gained widespread popularity in the endodontic community. It is easily obtained, affordable in large quantities, has superior antibacterial capabilities and provides lubrication and tissue dissolution as well. In the most common commercially available form, the pH of sodium hypochlorite is near 12. During the treatment of a root canal, the increase in pH likely creates a microenvironment that is not particularly hospitable to bacteria in the root canal system. Unfortunately, it can create severe problems if it is extruded past the apex of the tooth.

The smear layer is composed of both organic and inorganic components. This layer is created as a result of our efforts to instrument and disinfect the canal system. A number of solutions have been created to attempt to remove the smear layer. EDTA is the most well-known agent used for this reason. EDTA does not possess significant antibacterial properties. However, the use of EDTA clears dentinal tubules, ensuring that bacteria and bacterial byproducts are exposed to the rest of our irrigating solutions. There are a number of other agents that have been used to treat the smear layer as well.

The first agent, citric acid, is commercially available in a wide range of concentrations. BioPure MTAD (Dentsply Tulsa Dental) is a solution that is commercially available for root canal irrigation. It is a mixture of citric acid, doxycylcline and a detergent. It has shown both antibacterial activity as well as the ability to remove the smear layer.

SmearClear (SybronEndo) is another commercially available solution used in root canal irrigation. This is composed of 17 percent EDTA combined with surfactants. This solution has been shown to effectively remove the smear layer as well. It is thought that the surfactants further enhance the effectiveness of the cleaning

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process. Both EDTA and citric acid have also been used to facilitate the removal of calcium hydroxide from the root canal system, when this medicament has been used.

Hydrogen peroxide was used for many years as an endodontic irrigant. When combined with sodium hypochlorite it creates effervescence, which was thought to facilitate debris removal. In addition, the idea that peroxide acts as an oxidizing agent was extremely attractive to many dental professionals. Unfortunately, at high concentrations, hydrogen peroxide is not well tolerated in the body and might play a role in the development of cervical resorption. There is not a great deal of evidence supporting the use of hydrogen peroxide as an endodontic irrigant.

Water is used by some practitioners as an irrigant, as is local anesthetic. Both are biocompatible solutions, but offer no other benefits when compared with the other solutions listed above. I personally will use saline during the nonsurgical root canal therapy, but strictly as a means by which I can dilute and facilitate removal of other irrigants.

Chlorhexidine is an antibiotic solution commercially available for dental use. While it has been used for many years as a 0.12 percent solution known as Peridex, it is used in endodontics at two percent. It is highly antimicrobial, is known for its long-lasting effectiveness even after the removal of the solution and it does not provide any tissue dissolving properties. In addition, it is a highly reactive molecule, which creates problems when used in a multiple-irrigant regimen.

When sodium hypochlorite and chlorhexidine are mixed, an orange-brown precipitate known as para-chloroaniline is formed. It has been proposed that this agent might be carcinogenic, although that has not been substantiated. This precipitate is seen clinically as a difficult-to-remove, orange-brown film on tooth structure where the reaction occurs. As a highly reactive molecule, chlorhexidine also reacts with EDTA forming a precipitate that is whitish in color. The nature of this precipitate is not well known. In order to minimize interactions, I use three methods in varying combinations: high volume flush with saline, paper points and micro-suction. Used in combination, you can minimize the interactions. Unfortunately, despite our best efforts, due to the complexities of the root canal system, some of these precipitates will form if you use these irrigants.

Irrigation is traditionally delivered to the canal system using an irrigating syringe and tip. In addition, the use of gutta percha points with a pumping motion to assist in dispersing irrigants has also been used. The EndoActivator (Dentsply Tulsa Dental) is a device designed to sonically activate irrigants. It is battery operated, handheld and easily transported in the dental office. Over the years, the idea of energizing the irrigants, particularly sodium hypochlorite, has also been suggested. The

Table 1

Irrigant	Antimicrobial Activity	Smear Layer Removal	Reactive With	Safely Extruded
Sodium Hypochlorite	Yes	No	Chx	No
Hydrogen Peroxide	Yes	No	SH (bubbles)	No
Chlorhexidine	Yes	No	SH	No
EDTA	No	Yes	Chx	No
Citric Acid	No	Yes	-	No
Water	No	No	-	Yes
Local Anesthetic	No	No	-	Yes

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use of ultrasonic energy has been shown to increase canal cleanliness. Ultrasonic energy can be delivered by using IrriSafe (Satelec) ultrasonic tips, as well as by the use of the PiezoFlow (Dentsply Tulsa Dental). This device allows for ultrasonic activation of an irrigating tip, through which the irrigant of choice is dispensed.

Sodium hypochlorite is a widely used irrigant. However, if not handled properly the outcome can be a sodium hypochlorite accident. This can involve significant morbidity for the patient. In the interest of avoiding such a negative experience, it is strongly advised that practitioners pay close attention to working length, ensuring that the irrigation needle remain within the prepared canal. It is also important that the needle not be bound in the canal, but rather constantly be moved in and out of the canal. Side-vented needles assist in preventing the extrusion of irrigants beyond the most apical aspect of the needle tip. Finally, it is the responsibility of the dentist to avoid using excessive injection pressure while irrigating the canals.

When performing nonsurgical root canal therapy in my practice, I use full strength sodium hypochlorite from initial access until I complete canal preparation. Because we are dealing with canal systems that are irregular, I want to facilitate the movement of irrigants into the fins, crevices and anatomical anomalies that are untouched by instrumentation. For this reason, I will use the EndoActivator at various stages of canal preparation, depending on the circumstances. While no minimum amount of irrigant has been established, frequent replenishing of sodium hypochlorite in addition to the flushing action of active irrigation both assist with tissue dissolution.

"After microevacuation of each canal system, canal drying is confirmed using paper points."

At the conclusion of canal preparation, I will rinse the canals with copious saline, remove the excess by microcannula and dry the remaining solution using paper points. An application of 17 percent EDTA is performed, followed by another rinse with saline. This is then followed by the use of the PiezoFlow with sodium hypochlorite as the irrigant. I like to use a minimum of 20cc of solution per canal in this device. After microevacuation of each canal system, canal drying is confirmed using paper points. This is followed by the completion of the case. In the event that the case is treated with multiple visits, the use of the PiezoFlow is followed by drying in the method described above followed by placement of calcium hydroxide.

Irrigation is an often overlooked, but vital part of nonsurgical root canal therapy. While there are a number of solutions to choose from, it is up to each individual operator to develop and understand their irrigation protocol. This will allow the dentist to alter the protocol when necessary, but still achieve the biological objectives consistent with superior endodontic care. It is also worthwhile to evaluate the clinical adjuncts now available to assist us on our quest for cleaner root canals, and better long-term outcomes. ■

Author's Bio

Dr. David Carter received his DMD from the University of Connecticut School of Dental Medicine. Upon graduation, he completed a general practice residency at Newark Beth Israel Medical Center. After eight years practicing all phases of general dentistry, Dr. Carter earned his endodontic certificate from Lutheran Medical Center in Brooklyn, New York. He currently owns and operates Precision Endodontics, Ltd., a private practice limited to surgical and nonsurgical endodontics in Tempe, Arizona. He is a Fellow in the Academy of General Dentistry, and is recognized as Board Eligible by the American Board of Endodontics. He can be reached at drc@endoltd.com.