Irrigants in endodontics

Which are the best irrigants in endodontics and how are they used?

Background

In endodontics, the root canal system requires both mechanical and chemical preparation to achieve the goal of resolving or preventing apical periodontitis. Endodontic instrumentation alone may not access all pulp space surfaces and irregularities. Thus, root canal irrigants should possess ideal characteristics, including broad-spectrum antimicrobial properties, pulp tissue dissolution ability, periradicular tissue biocompatibility, lubricating action, chelating action to remove smear layer, and minimal allergic potential.[1] Although no substance yet combines all of these characteristics, clinicians must choose from the current available irrigation methods and materials. This article aims to review the irrigants that are most frequently used in endodontics and provide clinicians with tips on how to use them appropriately.

Sodium hypochlorite

The literature widely supports the use of sodium hypochlorite (NaOCl) solution as a root canal irrigant, as do the European Society of Endodontology and the American Association of Endodontics.

NaOCl is considered the gold standard irrigant mainly due to its antimicrobial and tissue-dissolving actions (**Figure 1**), and it can be found in concentrations of 0.5-6%. The most widely used, for safety reasons, are concentrations ranging from 0.5-2.5%. To maximise the effectiveness of NaOCl irrigation, the solution should be frequently refreshed and kept in motion by agitation or continuous irrigation. The speed of tissue dissolution can be increased with effective agitation and refreshment.[1] **Table 1** summarises the key pros and cons of NaOCl usage.

Complications and accidents

Despite its great advantages, NaOCl can be cytotoxic, and this can be a concern. NaOCl may extrude beyond the apical foramen, causing reactions ranging from mild discomfort to serious tissue damage.

Clinical tip

To help prevent these complications:

- use needles with lateral exit, at a depth short of the patency length of the root canal;
- control the force exerted on the syringe plunger during irrigation;
- do not let the needle stick to the root canal walls; and,
- opt for regular replacement of a weaker NaOCl solution (1-2.5%) with larger volumes, rather than using a higher concentration.

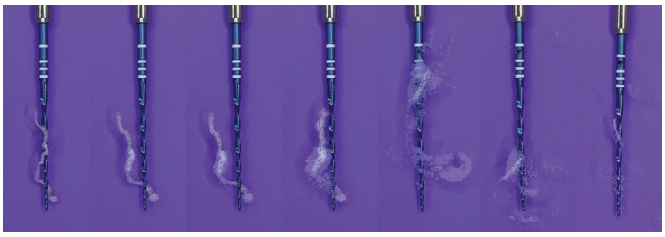

FIGURE 1: Evolution of tissue dissolution observed in pulp after a 40-minute exposure to 2.5% sodium hypochlorite.

Table 1: Main advantages and disadvantages of using NaOCl solution in endodontic treatment.

Advantages	Disadvantages
Antimicrobial activity	Cytotoxicity
Ability to dissolve pulp tissue	Delicate storage
Bleaching action	Strong smell
	Stains clothes

Chlorhexidine

The literature also supports the use of chlorhexidine (CHX), which is available in 2% aqueous solution and gel forms. Some of its desirable properties include antimicrobial activity and substantivity (residual action). However, unlike NaOCl, CHX does not dissolve pulp tissue, and this is one of its main disadvantages. CHX can be used as an alternative to NaOCl, especially in cases of necrotic teeth with an open apex, or when the patient reports an allergy to NaOCl. 2% CHX may also be considered for the final rinse after smear layer removal by ethylenediaminetetraacetic acid (EDTA). Care must also be taken with extrusion accidents, especially when using liquid CHX.[2]

Clinical tip

How to use 2% CHX gel:

- fill the canal with 2% CHX gel;
- start instrumentation;
- flush the canal with inert solution (saline solution or distilled water) to remove 'dirty' CHX gel;
- refill with 'fresh' 2% CHX gel;
- proceed with instrumentation; and,
- repeat until instrumentation is finished.

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Table 2: Main effects of irrigant mixtures and how to prevent by-product formation.

Combination	Reaction product	Clinical effect	How to prevent by-product formation
NaOCl + CHX	Orange-brown precipitate (**Figure 2**)	Potential discolouration and leaching of unidentified chemicals into the peri-radicular tissues.	Washing the root canal with a 5% sodium thiosulphate solution neutralises NaOCl.
NaOCl + EDTA	Chlorine gas bubbles	Low or null effect on calcium-chelating ability of EDTA.	Intermediate flushes with distilled water.
CHX + EDTA	Milky white precipitate	Unclear	Intermediate flushes with distilled water.

FIGURE 2: Brown precipitate (parachloroaniline) formation when 2% CHX was mixed with 2.5% NaOCl.

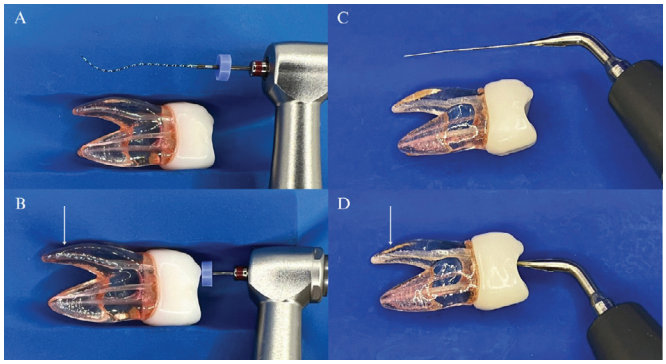

FIGURE 3: A and C: Xp-endo Finisher (FKG), and ultrasonic tip Irrisonic (Helse). B and D: Same instruments inserted into a root canal, 3mm short of canal length (arrows).

Ethylenediaminetetraacetic acid

EDTA (15-17%) is usually used after instrumentation, as a chelating agent to remove the inorganic component of the smear layer produced during root canal instrumentation, followed by an irrigation with NaOCl to remove the smear organic residue.

Effects of combining irrigants

Association of substances may lead to undesirable by-products, forming a chemical layer that can occlude dentinal tubules and interfere with filling.[3] **Table 2** shows the main effects of irrigant associations.

How to irrigate the root canals

Irrigants are typically delivered into the root canal using a disposable syringe and a fine needle (27-30 gauges) capable of reaching 2-3mm short of the canal length. Gentle pressure with a flow rate of around 4mL/min ensures effective and safe irrigation.[4]

Clinical tip
Activation

Traditional needle and syringe irrigation may fail to reach the full canal length. Enhance irrigant action with an agitation method, especially as a final step. This is known as dynamic/active irrigation.

Manual dynamic activation

- Flood the root canals with irrigant and place a well-fitting gutta percha cone 2-3mm short of the canal length; and,
- perform a repeated 'in and out' movement at a rate of around 100 strokes per minute, for one minute.[5]

Sonic irrigation

- Operate a sonic system such as EndoActivator System (Dentsply Sirona, USA), positioned 2-3mm within the root canal, at 10,000 cycles per minute for one minute.[5]

Passive ultrasonic irrigation (Figure 3)

- Set the ultrasonic device to 10% power;
- position a thin insert, like Irrisonic E1 (Helse Technology, Brazil), 2-3mm short of the canal length or until the curvature;
- activate for three 20-second cycles; and,
- refresh irrigating solution at the start of each cycle.

XP-endo finisher (FKG, Switzerland) (Figure 3)

- Calibrate the instrument to a position 2-3mm short of the canal length;
- cool the file with a coolant spray just before inserting it into the canal to maintain the straight shape; and,
- activate it with a rotary motion at 800-1,000rpm and 1N·cm of torque, for one minute.

Conclusion

Irrigation is an important step in endodontic treatment and must not be neglected. Appropriate chemicals and agitation optimise the effects of the irrigant, enabling more predictable patient care outcomes to be achieved.

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