Passive micro-volume management of sodium hypochlorite in endodontic treatment

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The passive utilization and micro-volume management of sodium hypochlorite as an endodontic irrigant has been reviewed with a laboratory demonstration and several clinical cases. By limiting the exposure to a rational utilization of sodium hypochlorite, the injurious effects can be minimized while still benefiting from the ideal disinfecting characteristics. Further studies are required to understand the behavior of fluids, especially sodium hypochlorite, within the context of permeability, fluid mechanics and multiphase fluid flow through porous media.

Introduction

Endodontic treatment addresses the removal of the tooth’s internal pulp and microorganisms, primarily due to infection and necrosis. Once proper diagnosis and prognosis has been established, the patient has the option of maintaining the tooth’s form and function while the vitality becomes lost. Current endodontic treatment consists of utilizing rotary files to remove the pulpal tissue and shape the internal dentin chamber of the tooth. Chemicals, in the form of gels and liquids, are then implemented to disinfect the canal(s) and eliminate bacteria. The chemicals are then dried and the canal space filled with either gutta-percha or resin to create a hermetic seal.

The chemicals employed to clean and disinfect the intra-canal space are vast and include file lubricants such as Prohobe (DENTSPLY) and irrigants such as CHX (DENTSPLY). During clinical endodontics, the canal is filled with a cetyl alcohol resin, as file lubricants and irrigants become a mixture.

Chlorhexidine gluconate (CHX) is an uncommonly used irrigant with several desirable properties. It provides antimicrobial activity against certain aerobic and anaerobic bacteria, exhibits no significant changes in bacterial resistance in the oral microenvironment and has no injurious effect to the skin or mucous. In fact, CHX has a role as an oral rinse at the 0.12 percent concentration.

Sodium hypochlorite (NaOCl) still remains the most commonly used chemically due to its availability, cost and effectiveness. Sodium hypochlorite is effective against broad-spectrum bacteria and has the ability to dissolve both vital and necrotic tissue. However, this irrigant is equally damaging to the patient and has a history of injurious effects.

Typically the NaOCl is delivered into the canal space with a syringe dose of 2-10 ml that is expelled under pressure. The ability of NaOCl to escape either through poorly sealed isolation or other means can cause serious injury to the patient.

Injury from NaOCl is well established in the literature and has been attributed to three main errors: poor handling, injection beyond the apical foramen and allergy. Poor handling injury can result in operator and/or patient injury to the eye and/or skin. Injection beyond the apical foramen can result in the following:
- immediate and severe pain
- edema to adjacent tissue
- edema to the lip, infraorbital region and side of face
- intense bleeding from within the canal space
- skin and mucous bleeding
- intestinal bleeding
- parasympathetic secondary infection.

Allergy from NaOCl is rare but has been reported and may result in severe pain, a burning sensation, edema and transient paraesthesia.

Methodology

Although there is no universally accepted irrigation protocol regarding endodontic treatment, it is the duty of clinicians to apply evidence-based dentistry within clinical parameters to provide their patients with the highest standard of care with minimal morbidity. The use of NaOCl has numerous beneficial factors that maximize treatment success; however, it is the application of the liquid that can cause injury.

Micro-volume management of NaOCl has been proposed. The concept is based on the premise that endodontic instruments have irregular surfaces, crucial for dentinal preparation, and that liquids exhibit surface tension characteristics. By placing an instrument into a suitable container, the NaOCl will be diluted liquids, then the successful removal of those liquids is key to clinical success. Concepts of multiphase fluid flow through porous media, and capillaries, permeability of porous media and surface tension fluid mechanics must be recognized to validate and further advance canal irrigation.

Micro-volume management of NaOCl has been suggested as a delivery modality to maximize its bactericidal effects yet minimize its injurious effects. Surface tension fluid mechanics and permeability suggest that the NaOCl can be carried within the surface irregularities of endodontic instrumentation and deposited into the canal space and percolate within the complex network of the canal. The passive management of the irrigant in micro-volume would greatly reduce complications due to poor handling. CHX has...
The application of micro-volume management of NaOCl suggests that the canal space can be effectively cleaned in a conservative manner. Application of this principle has been applied to clinical cases with little to no post-endodontic sensitivity. Obturation has been completed with ThermaSeal and Thermafil (DENTSPLY). Even though there is evidence of sealer extrusion, the absence of post-operative symptoms and pathology suggests adequate volume for sufficient disinfection.

Further laboratory studies are required to understand permeability, fluid mechanics and multiphase fluid flow through porous media and their relation to the micro-management of NaOCl. Additional clinical investigations should be implemented to assess and validate the efficiency and efficacy of micro-volume management of sodium hypochlorite on endodontic therapy.

Conclusions

Introduction of lubricants and irrigants into the canal complex is crucial for endodontic success. The action of fluids in the canal complex must be understood within the context of permeability, fluid mechanics and multiphase fluid flow through porous media. NaOCl has several advantages for its role as an endodontic irrigant, but its use must be exercised with caution in order to prevent injury.

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References

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