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 accepted with a laboratory demonstration and several clinical cases. By limiting the volume of NaOCl utilized to the canal network, 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 gutta-percha or resin to create a hermetic seal. The chemicals employed to clean and disinfect the intracanal space are vast and include file lubricants such as Prolube (DENTSPLY) and irrigants such as QMix (DENTSPLY) and irriGel (DENTSPLY). Allergy from NaOCl is rare but has been reported and may result in severe pain, a burning sensation, edema and transient paraesthesia.

Fig. 1 DENTSPLY Vortex rotary file with sodium hypochlorite. (Photos/Provided by Les Kalman, B.Sc(Hon), DDS)

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 carried within the surface tension of the liquid to percolate into the canal space (Fig. 4). As the operator inserts the instrument into the canal (Fig. 2), the NaOCl is carried with it. Upon instrument movement, the NaOCl is carried into the canal space (Fig. 4). Surface tension and permeability of porous media (dentin) will also increase the ability of the liquid to percolate into the canal. This approach is radically different than current philosophies, as the NaOCl is introduced into the canal space in a micro-volume amount without any pressure. The operator has control of the minimized liquid while benefitting from its effectiveness.

Micro-volume management of NaOCl has been applied to numerous clinical cases. Post-operative obturation radiographs of completed clinical cases have been presented (Figs. 5-9).

Discussion

The 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 been distinguished.

Fig. 4 Sodium hypochlorite in block with rotary file.

The canal system inside a tooth is very complex. Although there is the presence of one or more canals, there also exist numerous micro tunnels, ribbons and sheets throughout the canal network. The canals are also housed within a complex tubular structure, for which the permeability has been distinguished. Although the elimination of the pulp is a relatively predictable clinical procedure, the introduction of liquids into this complex micro-network porous development further complicates matters. If the clinician introduces liquids, then the successful removal of those liquids is key to clinical success. Concepts of multiphase fluid flow through porous media, and capillaries, 10 permeability of porous media and surface tension fluid mechanics must be recognized to validate and further advance canal irrigation.
been suggested as the larger volume, positive pressure irrigant that may be delivered into the canal space. CHX has favorable antibacterial characteristics but minimal injurious effects, if mismanagement of the irrigant has occurred. If positive pressure delivery of CHX is required, the operator should regulate the pressure and avoid the risk of injection beyond the apex. The use of EDTA (ethylene-diaminetetraacetic acid) could be employed after NaOCl, to minimize the formation of precipitates.2

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 ThermSeal 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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