Original Article

Preparation and characterization of novel nano-tricalcium silicate-58s bioactive glass-based root canal sealer

Abstract

Introduction: Calcium silicate-based root canal sealers are gain significant interest in the recent endodontic treatment, but the high solubility and long setting time are the most shortcoming. Therefore, this study aimed to develop new nano-tricalcium silicate-58s bioactive glass (BG)-based root canal sealer with phosphate-buffered saline (PBS) as a liquid precursor, as well as to evaluate the hydration reaction of the newly prepared sealer.

Materials and Methods: Different formulae were prepared by adding nano-zirconium dioxide (ZrO_2) and 58s BG to the tricalcium silicate (C_3S) at different concentrations. Furthermore, two types of liquid were used as precursors (PBS and distilled water). Then after, the setting time and solubility were evaluated for each prepared formula. Statistical analysis was performed using analysis of variance and Tukey tests. The formula that had the best properties was characterized by X-ray diffraction and Fourier transform infrared spectroscopy.

Results: It was found that the ZrO_2 at 25%, BG at 30%, and the use of PBS as a liquid improved the physical properties of the prepared sealer. Results indicated that the main hydration reactions by products for the best formula were noncrystalline calcium silicate hydrate, crystalline $Ca(OH)_2$, $CaCO_3$, $Ca(H_2PO_4)_2$, $Ca_3(PO_4)_2$, and hydroxyapatite.

Conclusions: The experimental formula that composed mainly of 45% C_3S, 25% ZrO_2, and 30% BG as a powder and PBS as a liquid precursor had superior which is in line with the American Dental Association specification.