

Investigation of Dentinal Surface Coating by Nano-hydroxyapatite

H. KAWAMATA, K. OHTA, T. SAITO, and R. HAYMAN
SANGI Co., Ltd, Tokyo, Japan

Objectives: Hypersensitivity occurs when dentinal tubules are exposed, allowing transmission of external stimuli to the nerves. Potassium nitrate (KNO₃), used in anti-hypersensitivity toothpastes, is known to release potassium ions which block this transmission. We previously reported that nano-hydroxyapatite (nHAP) occludes dentinal tubules and forms a protective coating on the dentin surface (IADR 2007), and that KNO₃ enhances these effects (2008). But despite similar reports of dentinal tubular occlusion and surface coating by nHAP-containing compounds (Franke et al 2006, Peschke et al 2007, Lee et al 2008, Besinis et al 2009), the nature of the surface layer has not been examined. We investigated the dentinal surface after treatment with nHAP toothpaste containing KNO₃.

Methods: Sections of extracted human teeth polished to expose the dentinal tubules were dipped in a solution of nHAP toothpaste with KNO₃ for 9 min daily at 37 degrees C for 5 days. Between dippings, specimens were stored in humid conditions at 37 degrees C. The treated surface was then subjected to field emission-type scanning electron microscopy (FE-SEM), energy-dispersive X-ray spectroscopy (EDX) and thin-film X-ray diffractometry (TF-XRD), using parallel beam instead of conventional focusing, to avoid penetrating deeper than 10 micrometers into the dentin substrate.

Results: FE-SEM showed perfectly occluded dentinal tubules and a uniform dental surface coating about 1.8 micrometers thick. EDX detected calcium and phosphorous in this coating, but no potassium. TF-XRD indicated that the surface layer comprised crystalline hydroxyapatite and amorphous compounds.

Conclusions: We concluded that formation of crystalline hydroxyapatite on the dentin surface provides a useful protective layer against acid erosion and dentin hypersensitivity. The absence of potassium in this layer suggests KNO₃'s role in promoting surface coating may be to alter the solubility of nHAP, while the amorphous phase may play an important role in the attachment of nHAP to the dentin surface.