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Research paper

Influences of ionic concentration on nanomechanical behaviors for remineralized enamel

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ABSTRACT

This study evaluates the influences of 8DSS peptide and ionic concentrations of simulated body fluid on remineralization behaviors. The polished enamel specimens were acid-demineralized, exposed briefly to 8DSS peptide solution, and then immersed into simulated body fluid (SBF) that favors mineral deposition. At various stages of treatment, nanohardness and elastic modulus were determined by nanoindentation. The results show that the nanomechanical properties of the acid-demineralized enamel were greatly improved as increasing the ionic concentrations of SBF due to the acceleration of mineral deposition. Additionally, the demineralized enamel, treated with 8DSS peptide and immersed into SBF×2 solution, possesses the highest values of nanohardness and elastic modulus resulting from the combinative effects of surface roughness, morphology, microstructure and crystallinity of the newly formed nanocomposite of calcium phosphate carbonate and hydroxyapatite. The formation of pores in the subsurface induced a reduction in the nanomechanical properties for the enamel subjected into SBF×3 solution.

1. Introduction

Human enamel is a highly mineralized extracellular matrix including 96% inorganic mineral and 4% organic material with water. The inorganic mineral is a crystalline hydroxyapatite (HA) organized in a highly complex three-dimensional micro- and nano-architecture that contributes to the remarkable hardness of enamel (Landis et al., 1993; Nanci, 2003).

Enamel is relatively stable in a healthy oral environment, where saliva and oral fluid continuously promote the balance between dissolution and deposition of minerals. However, if dissolution occurs at a rate kinetically greater than that of mineral deposition, demineralization or dental caries can result (Suga and Watabe, 1992; Cuy et al., 2002). Currently, the most common and effective treatment for clinically detectable caries is to fill the decayed tissue with artificially restorative materials. However, promoting the remineralization of small, incipient demineralized lesions before they advance into full lesions is a preferred approach (ten Cate and Featherstone, 1991). At a minimum,

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