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Effects of an orthodontic primer containing amorphous fluorinated calcium phosphate nanoparticles on enamel white spot lesions

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ABSTRACT

Objectives: The study investigated the effects of an orthodontic primer containing amorphous fluorinated calcium phosphate (AFCP) nanoparticles on enamel white spot lesions (WSLs).

Materials and methods: The AFCP nanoparticles were prepared and incorporated into Transbond XT Primer. Thirty-two human enamel slices were highly polished and randomly divided into four groups: no part covered (control), half covered with a primer containing 0 wt%, 25 wt%, and 35 wt% AFCP. Subsequently, samples were challenged by a modified pH-cycling and characterized by color measurement, micro-computed tomography, and scanning electron microscope (SEM). The bonding properties of the primers containing AFCP were assessed using shear bond strength test, and the mouse fibroblasts (L929) were employed to evaluate the cytotoxicity.

Results: When the enamel was challenged by pH cycling, 25 wt% and 35 wt% AFCP groups exhibited less color change (ΔE) and less mineral loss than the control and 0 wt% AFCP groups. The SEM images showed that the original microstructural integrity and mineral deposition rate of the enamel surface were better in the 25 wt% and 35 wt% AFCP groups. In particular, the 35 wt% AFCP group exhibited the best performance after 3 weeks of pH cycling. The shear bond strength and cell viability revealed no significant difference among the tested groups (P > 0.05).

 ${\it Conclusion:} \ \ Using \ the \ primer \ containing \ 35 \ wt\% \ AFCP \ might \ be \ a \ promising \ strategy \ for \ preventing \ the occurrence \ and \ development \ of WSLs \ during \ orthodontic \ treatment.$

1. Introduction

With the increased concern on oral health and esthetics, orthodontic treatment is considered by an increasing number of patients. Fixed orthodontic treatment is currently a mainstream orthodontic procedure (Li et al., 2020), and white spot lesions (WSLs) is an inherent complication (Chaichana et al., 2022). Routine oral hygiene measures are complicated by the long-term placement of fixed orthodontic appliances. The

difficult-to-clean surface provides a favorable condition for bacteria, and the bacterial acid metabolite causes partial enamel demineralization, resulting in chalky pigmentation and thus progressing to caries and affecting esthetics (Erbe et al., 2021). Enamel demineralization represents the initial developing stage of a carious lesion. Therefore, effectively preventing the occurrence of WSLs is a very popular research topic.

Hydroxyapatite (Ca₁₀(PO₄)₆(OH)₂) is of biological importance

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