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Remineralization Potential of Nano-strontium/Fluoride Hydroxyapatite on Artificial Enamel Caries

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Abstract

Objectives: This study aimed to evaluate the remineralization efficacy of nano-strontium/fluoride hydroxyapatite paste on initial enamel caries in comparison with other remineralization products under a simulated pH-cycling model.

Methods: Following the artificial caries induction, forty enamel specimens with non-cavitated lesion in the same range of lesion depth were selected by mean of micro-CT evaluation. The specimens were block-randomized into four experimental groups regarding remineralizing pastes: 1500 ppm sodium fluoride paste, 10%wt nano-hydroxyapatite paste, 10%wt nano-strontium/fluoride hydroxyapatite paste and 5%wt nano-strontium/fluoride hydroxyapatite paste. Remineralizing effect was evaluated using micro-CT, while SEM/EDS line scan mode facilitated the investigation of remineralization patterns. Changes in lesion depth (ΔLD) and changes in mineral loss (ΔΔZ) were evaluated at 7 and 14 days of treatment under the pH-cycling model. Statistical analyses were performed using 2-way ANOVA and post hoc Tukey's test ($p<0.05$).

Results: The use of 5%wt nano-strontium/fluoride hydroxyapatite paste significantly reduced lesion depth in initial caries under experimental conditions. Meanwhile, the 10%wt nano-strontium/fluoride hydroxyapatite paste yielded the highest mineral gain, though statistically insignificant. EDS graphs indicated an increasing calcium and phosphorus deposition trend over time with nano-strontium/fluoride hydroxyapatite paste, revealing a more uniform mineral distribution compared to both sodium fluoride and nano-hydroxyapatite pastes. Nevertheless, neither fluorine nor strontium was detectable in these graphs.

Conclusions: The study revealed comparable remineralization efficacy with 5%wt and 10%wt nano-strontium/fluoride hydroxyapatite pastes. The treatment durations of 7 and 14 days showed no significant difference in outcomes.

Keywords: initial caries, lesion depth, mineral gain, nano-strontium/fluoride hydroxyapatite, remineralization