Established pH Cycling Model Also Exhibits Dose Response to SnF₂

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ABSTRACT

The majority of in vitro fluoride dose responses are demonstrated using sodium fluoride at 1100ppm F and lower dose negative controls (250ppm F or placebo) or higher dose positive controls (2800ppm F). Objectives: The primary aim of this research was to determine if a well-established pH cycling model is capable of demonstrating a dose response to stannous fluoride, another Category 1, safe and efficacious fluoride salt included in the FDA's Anticaries Final Monograph. Methods: Bovine enamel blocks (n=10/group) were prepared, polished and subjected to 9 days of pH cycling. Specimens were treated with fluoride slurries (1 part dentifrice, 3 parts water, mixed thoroughly 1 min treatment) followed by demineralization solution (6 hrs, 37°C, 0.9mmol/l Ca++, 0.9mmol/l P04°). After cycling, specimens were cut longitudinally through the lesion and analyzed using cross-sectional microhardness. Mean Delta Z values were calculated for each treatment group and statistically analyzed (ANOVA, Tukey-Kramer, p<0.05). Results: The results (Mean Delta Z ± SEM) were as follows: 1100ppmF = 1425 ± 136, 250ppmF = 2785 ± 168 and 0ppmF = 3490 ± 1100ppmF. These differences were significant (1100ppmF<250ppmF<0ppmF). Conclusions: Based on these results, we conclude that well-established pH cycling model is capable of demonstrating a dose response to stannous fluoride, similar to results shown previously for sodium fluoride.

INTRODUCTION

In vitro cycling studies have been successfully used to demonstrate anticaries potential of fluoride containing dentifrices for several decades. Dose responses using sodium fluoride have recently been presented (1,2), yet dose responses to stannous fluoride have not been confirmed. The aim of this study was to determine if a well-established cycling model (3,4) also exhibited a dose response to stannous fluoride. Methods described recently by Toda were utilized (5).

MATERIALS AND METHODS

5 x 5mm bovine enamel chips were cut and mounted in 12x12mm cuvettes with a cold-set acrylic (Citofix/Durafix, Streurers AS, Denmark) (Fig. 1). Chips were flattened using a 121. Chips were cut in half (through the lesion) using a radial diamond saw. One half of each chip was embedded in epoxy resin with the cut face of the chip exposed. Cut faces were polished to a high luster and microhardness indentations were made on a line perpendicular to, and initiated at 12.5 μm from the anatomical surface of the lesion. The hardness indenting was continued to depths extending into the underlying sound enamel, at 12.5 or 50 μm intervals. Measurements were made using a standard microhardness indenter equipped with a Knoop diamond. Both 10g and 50g loads were used. Knoop hardness numbers were converted to volume % mineral and individual volume % mineral values analyzed using cross-sectional microhardness. Mean Delta Z values were calculated for each treatment group and statistically analyzed (ANOVA, Tukey-Kramer, p<0.05).

RESULTS

 Treatment: Groups of chips were treated for one minute with dentifrice and water slurries (1 part dentifrice, 3 parts water, thoroughly mixed for 4 minutes). Chips were thoroughly rinsed. Groups were placed collectively into vials containing 400ml of demineralizing solution (pH<4.6) for six hours at 37°C. Chips were thoroughly rinsed. Chips were treated again with fresh dentifrice and water slurries. Chips were placed into vials containing 200ml of remineralizing solution (pH=7.0, 37°C) for 16 hours (overnight). The cycling was repeated 8 times for a total of 9 days of treatment.

Analysis: Treated chips were cut in half (through the lesion) using a radial diamond saw. One half of each chip was embedded in epoxy resin with the cut face of the chip exposed. Cut faces were polished to a high luster and microhardness indentations were made on a line perpendicular to, and initiated at 12.5 μm from the anatomical surface of the lesion. The hardness indenting was continued to depths extending into the underlying sound enamel, at 12.5 or 50 μm intervals. Measurements were made using a standard microhardness indenter equipped with a Knoop diamond. Both 10g and 50g loads were used. Knoop hardness numbers were converted to volume % mineral and individual volume % mineral values plotted versus depth permitting calculation of mineral loss (Delta Z).

CONCLUSION

All of the dentifrice formulations containing fluoride were shown to inhibit demineralization and/or promote remineralization better than the placebo control.

This well-established pH cycling model is able to demonstrate a dose response to stannous fluoride.

References:


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