Calcium Release of Experimental Dental Varnishes

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Introduction: Fluoride varnish has been utilized in dentistry's preventive care protocols since 1991. Initially, the predicted preventative results of fluoride varnish were quite optimistic, but nine published clinical trials in children ages 1-3 years old found the prevention of carious lesions was small and therefore documented a lack of significant effect. In addition, there remains the issue of a dental professional needing to apply the fluoride varnish for use.

Objective: To determine the amount of Ca^{2+} released by the newly introduced, take home, care-giver applied Ca^{2+} and xylitol varnishes.

Materials and Methods: Four groups consisting of different dental varnish formulations were utilized for this study. The four groups were experimental varnish with xylitol, experimental varnish without xylitol, FluoroCal® with xylitol and FluoroCal® without xylitol. For each group, 10 specimens were made by painting the varnish on coverslips. The mass of each coverslip was taken and recorded before and after varnish placement. The finished coverslips were then dried in a 37°C oven. Once dry, each coverslip was placed in a vial filled with deionized water and then placed in a 37°C oven for 3 hours. 10 mL of the solution of each vial was then transferred into a beaker with 0.2 mL Ca ISA and a magnetic stir bar. ISE (Orion meter with calcium electrode Orion 720A+) was used to measure the calcium present in each solution and this value was recorded. To calculate the Ca^{2+} release, the Ca^{2+} measurement was divided by the mass of the varnish layer. Statistical analyses were then performed for the different data sets.

Results: Experimental varnish without xylitol released more Ca^{2+} ion than the experimental varnish with xylitol. A multiple range test estimated that the difference between the two samples is statistically significant. For FluoroCal®, there was no difference in Ca^{2+} ion release between the datasets with or without xylitol. Overall, the experimental varnish released 175+ times more Ca^{2+} ion than the Ca^{2+} ion fluoride varnish.

Figure 1. Varnish samples

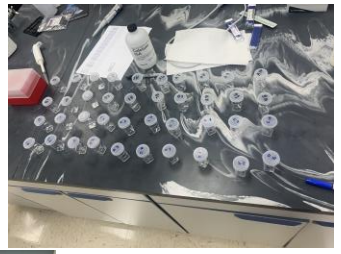

Figure 2. Varnish cover slips in deionized water

Figure 3. Measuring Ca++ with Orion meter with calcium electrode

Summary Statistics							
	Count	Average	Standard deviation	Coeff. of variation	Minimum	Maximum	Range
21-2211 Commercial FLUOROCAL	10	73	16	22%	37	93	56
898-159 FLUOROCAL sans Xylitol	10	61	9	15%	50	78	28
898-157 experimental with Xylitol	10	11329	1279	11%	9652	13372	3720
898-158 experimental sans Xylitol	10	12817	723	6%	11217	13691	2474

Table 1. Comparison of dental varnish statistics.

Multiple Range Tests			
Method: 95.0 percent LSD			
	Count	Mean ppm	Homogeneous Groups
898-159	10	61	X
21-2211	10	73	X
898-157 (with Xylitol)	10	11329	X
898-158 (sans Xylitol)	10	12817	X

Table 2. Multiple Range Tests for statistical significance

Discussion: A take home dental varnish that releases a significant amount of Ca^{2+} ion would be safe for young children and easily applied by a caregiver. This take-home varnish could be applied weekly at home or in a facility for special health care needs patients providing significant oral health benefits. Research, including large clinical trials, is indicated to determine the overall effectiveness of this experimental varnish. There should also be animal studies performed with exposure to the varnish to determine any cytotoxicity/systemic effect to ensure safety. However, due to the reported lack of sufficient Ca^{2+} ion in the diet of many young patients and elderly, the consumption of any varnish is likely to have more beneficial than negative consequences. A typical Ca^{2+} ion supplement has anywhere between 400 to 1200 mgs calcium, far exceeding the amount used in this experimental varnish treatment. The amount of salivary Ca^{2+} ion needed for enhanced re-mineralization is estimated to be greater than 1.23 mMol/L. Because unstimulated saliva flow is approximately 0.3-0.4 ml minute and 1.1 mls stimulates swallowing, the Ca^{2+} ion release by the experimental varnishes should stimulate salivary flow and re-mineralization.
The effectiveness of caries prevention by fluoride varnish at different ages may be due to age related balances of pathogenic and protective factors. Dietary sugars, hygiene, and the composition of the dental plaque play a larger role than the enhancement of remineralization potential by fluoride varnish. In addition, different fluoride varnishes vary in their effectiveness; no clinical testing has been done on the preventive effect of most fluoride varnishes currently on the market. Fluoride in the varnish preparations reduced the Ca^{2+} Ion release, most likely due to formation of Ca^{2+} fluoride salt which is insoluble and non-bioactive. Therefore, the Ca^{2+} ions were not as detectable with the Orion ion meter for the traditional fluoride varnish.
Xylitol has been extensively studied and demonstrated to inhibit dental caries and to further inhibit periodontal and cariogenic pathogenic bacteria.[1-3] In addition, xylitol has been reported to have oral anticancer properties and be a Ca^{2+} ion carrier to enhance re-mineralization.[4,5] Future clinical studies should determine the viability of a take home calcium and xylitol varnishes and include more varnishes comparisons.

Conclusions: A Ca^{2+} ion releasing dental varnish for take-home use by caregivers may have significant beneficial results in a dental preventive care program. Fluoride reduces the level of bioavailable calcium in dental varnishes and limits the use of traditional varnishes to application by a professional.

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