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In Vitro Study Comparing Treatment for Incipient Enamel Lesion Remineralization Aliyah Wilson DDS, MS¹, Sahar Alrayyes DDS, MS¹, Azza T. Ahmed PhD, BDS, MS¹, Evelina H. Kratunova

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BACKGROUND

- Dental caries remains one of the most widespread chronic conditions in children from industrialized nations, driven primarily by bacterial fermentation of dietary carbohydrates that leads to localized demineralization of dental hard tissues.
- The disease is initiated and sustained by cariogenic plaque structured microbial communities that produce acidic metabolic by-products, creating an environment conducive to the progressive breakdown of tooth structure.
- If left untreated, caries in primary dentition can result in pain, infection, and premature loss of teeth, contributing to space maintenance issues, malocclusion, and more complex orthodontic challenges later in life.
- Beyond oral health, pediatric dental caries are associated with broader socioeconomic consequences, including increased school absences, caregiver work disruptions, and elevated healthcare utilization.

OBJECTIVES

This study compared the remineralization efficacy of Icon™, 3M™ Varnish™ 5% Sodium Fluoride White Varnish (FV), and 38% Silver Diamine Fluoride (SDF; Advantage Arrest[™]) on enamel surfaces affected by incipient caries lesions.





E2[¶] or RA2[#] D1[¶] or RA3[#] E1[¶] or RA1[#] Radiolucency may extend to the dentinoenamel junction or outer one-third of the dentin. Note: radiographs are not reliable for mild occlusal lesions.

Figure 1: Radiographic Presentation of the Approximal Surface

METHODS

Caries-free permanent teeth, extracted for orthodontic or surgical purposes, were obtained from the Pediatric Dentistry Department at UIC COD. Enamel samples (4 mm x 5 mm) were prepared, frozen, and subjected to baseline microhardness testing.





Figure 2: Utilized Caries Interventions

Samples were randomized into four groups (n=5/group): Icon, FV, SDF, and a control group. Artificial caries lesions were induced and treated per manufacturers' instructions. Samples were immersed in a saliva-like remineralization solution for seven days, and post-treatment microhardness was assessed at 20 μ m intervals to a depth of 200 μ m.



Figure 3: Enamel Samples Before (Left) and After (Right)Acid-Resistant Nail Polish



Figure 4: Study Flow

Statistical analyses included ANOVA with Tukey-Kramer post hoc tests and Generalized Estimating Equation (GEE) modeling. The statistical analysis When managing incipient caries, all three materials are effective options for addressing presented was supported by the University of Illinois Chicago Center for early caries lesions. However, FV and Icon provided superior remineralization and surface Clinical and Translational Science (CCTS). CCTS is supported by the hardening when compared to SDF. This could translate into better resistance to National Center for Advancing Translational Sciences, National Institutes of mechanical wear and secondary caries formation, supporting its use as a preventive Health, through Grant UL1TR002003. strategy in patients at high risk for enamel demineralization

RESULTS



Figure 5: Microhardness Test of Enamel



Table 1: Summary of GEE Model Reference Group and Depth Effect

| Analysis Of GEE Parameter Estimates | | | | | | | |
|-------------------------------------|----------|----------|----------|-----------------------|----------|-------|---------|
| Empirical Standard Error Estimates | | | | | | | |
| | | | Standard | | | | |
| Parameter | | Estimate | Error | 95% Confidence Limits | | z | Pr > Z |
| Intercept | | 197.4246 | 15.1170 | 167.7958 | 227.0534 | 13.06 | <.0001 |
| group | Fluoride | 17.8261 | 23.9762 | -29.1663 | 64.8185 | 0.74 | 0.4572 |
| group | ICON | 12.7615 | 25.2430 | -36.7138 | 62.2369 | 0.51 | 0.6132 |
| group | SDF | -76.3146 | 38.6218 | -152.012 | -0.6171 | -1.98 | 0.0482 |
| depth | | 0.4558 | 0.0793 | 0.3004 | 0.6113 | 5.75 | <.0001 |
| depth*group | Fluoride | 0.1327 | 0.0836 | -0.0312 | 0.2965 | 1.59 | 0.1125 |
| depth*group | ICON | 0.0168 | 0.0899 | -0.1594 | 0.1929 | 0.19 | 0.8519 |
| depth*group | SDF | -0.1627 | 0.2602 | -0.6727 | 0.3472 | -0.63 | 0.5317 |

Figure 6: Mean and Standard Deviation of Enamel Microhardness Across Depths by Treatment Group



Table 2:GEE Model Depth Effect



CONCLUSIONS

SDF demonstrated the lowest microhardness values, with a mean of 147.24 (SD: 39.76) at 100 µm, significantly lower than FV (276.54; SD: 33.72), Icon (254.59; SD: 30.18), and the control (253.19; SD: 36.16). FV and Icon showed significantly higher microhardness, indicating superior enamel strengthening compared to SDF. No significant differences were found between FV and Icon.



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REFERENCES