University of Kentucky College of Dentistry

Water Sorption and Solubility of New Resin Infiltrant

Murphy Conlin, D.D.S. [1], Nayara Rodrigues, D.D.S.[1], **Cristina Perez,** D.D.S. MS [1], **Morgan Larkin**, D.M.D.[1], **Debora Scheffel,** D.D.S, M.S, PhD [1]

INTRODUCTION

Resin infiltration has emerged as an effective micro-invasive treatment for addressing white spot lesions and enamel hypomineralization, offering a promising alternative to more invasive restorative approaches. The ideal resin infiltrant not only penetrates and fills enamel porosities but also supports enamel remineralization and exhibits long-term stability.

However, the clinical success of these materials is largely determined by their ability to resist water sorption and solubility. These properties are critical because excessive water uptake can weaken the material's structural integrity, leading to degradation and ultimately compromising the restoration's longevity. Understanding and improving these material properties are essential for enhancing the durability and effectiveness of resin infiltrants in long-term clinical applications.

OBJECTIVE

This study aimed to evaluate the water sorption and solubility of eight experimental resin infiltrants containing ceramic particles and antimicrobial agents.

MATERIAL AND METHODS

Specimens were obtained by dispensing 50 µL of each resin into standardized molds (5 mm × 2 mm) (n=6). The specimens were polymerized using a light-curing unit for 60 seconds. Following polymerization, the specimens were subjected to a desiccation cycle in a drying oven at 37°C for 22 hours and 23°C for 2 hours each 24-hour cycle until a constant mass (M1) was achieved. After obtaining M1, the specimens were measured, and the volume of each of them was calculated. The specimens were then immersed in distilled water at 37°C for 7 days. After immersion, the specimens were removed, blotted dry, and weighed to record their intermediate mass (M2). The specimens were returned to the drying cycle oven until a second constant mass (M3) was attained. Water sorption (WS) (µg/mm³) and solubility (µg/mm³) were determined based on the masses and volume of each specimen. Data were analyzed using Kruskall-Wallis and Dunn's tests (α=0.05).

Figure 1. Step-by-step preparation of experimental resin: monomer and photo-initiator mixture, incorporation of ceramic nanoparticles, followed by light curing for photoactivation.

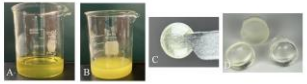

Figure 2. A) resin without nanoparticules. B) resin with nanoparticules. C-D) Cylindrical specimens of experimental resins showcasing uniform shape and size.

Figure 3. Cycle of Water Sorption and Solubility Testing. Stable mass (M1), Mass after water exposure (M2). Final weighing with stable mass (M3). WS = (m2 − m3)/V; SL = (m1 − m3)/V

RESULTS

WS was similar among the groups (p>0.05). The combination of ceramic particles and the antimicrobial agent significantly increased the solubility of the experimental resins compared to the control (ICON).

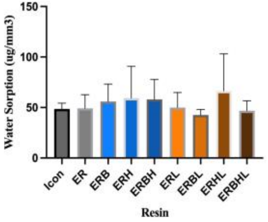

Figure 4. Water sorption. ER = Experimental Resin; ERB = Experimental Resin + particle 1; ERH = Experimental Resin + particle 2; ERBH = Experimental Resin + particles 1 and 2; ERL = Experimental Resin + antimicrobial agent; ERBL = Experimental Resin + antimicrobial agent + particle 1; ERHL = Experimental Resin + antimicrobial agent + particle 2; ERBHL = Experimental Resin + antimicrobial agent + particles 1 and 2. (Kruskall-Wallis and Dunn's tests ; p>0.05).

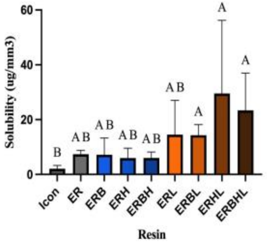

Figure 5. Solubility of experimental resins after 7 days of storage. Different letters show significant difference among the groups. (Kruskall-Wallis and Dunn's tests ; p<0.05).

ACKNOWLEDGMENTS

This study was funded by the Impact grant DIRECT (Dental Integrated Research Education and Clinical Training) faculty and Student Pilot Research Award.

CONCLUSIONS

The addition of ceramic particles and the antimicrobial agent did not affect the WS and solubility of the experimental resins. However, the combination of both agents increases solubility.

[1]Department of Oral Health Science, University of Kentucky College of Dentistry

1. MATICK, A. C. C., NAVARRO, C. H., HIGASHI, D. T., PASCOTTO, R. C., FUJIMAKI, M., & TERADA, R. S. S. (2019). Avaliação da solubilidade e sorção em água de alguns materiais restauradores diretos. Revista de Odontologia da UNESP, 48. https://doi.org/10.1590/1807-2577.12818. 2. Prodan, D., Moldovan, M., Chisnoiu, A. M., Saroși, C., Cuc, S., Filip, M., Gheorghe, G. F., Chisnoiu, R. M., Furtos, G., Cojocaru, I., Delean, A. G., & Cimpean, S. I. (2022). Development of New Experimental Dental Enamel Resin Infiltrants—Synthesis and Characterization. Materials, 15(3), 803. https://doi.org/10.3390/ma15030803 3. Jardim, R.N.; Rocha, A.A.; Rossi, A.M.; de Almeida Neves, A.; Portela, M.B.; Lopes, R.T.; dos Santos, T.M.P.; Xing, Y.; da Silva, E.M. Fabrication and characterization of remineralizing dental composites containing hydroxyapatite nanoparticles. J. Mech. Behav. Biomed. Mater. 2020, 109, 103817. 4. Gajewski, V.E.S.; Pfeifer, C.S.; Fróes-Salgado, N.R.G.; Boaro, L.C.C.; Braga, R.R. Monomers used in resin composites: Degree of conversion, mechanical properties and water sorption/solubility. Braz. Dent. J. 2012, 23, 508–514