

Antimicrobial and Mechanical Properties of Bioactive Glass Reinforced Dental Composites

D. Khvostenko¹, J. Kruzic¹, J.L. Ferracane², J.C. Mitchell².

¹Materials Science, Oregon State University, Corvallis, OR, ²Dept. of Restorative Dentistry, Oregon Health & Science University, Portland, OR.

Statement of Purpose: Over the last fifteen years many results have been published documenting composite failure rates and the primary reasons for composite replacements. Results of most of work highlight secondary marginal caries to be the most common reason for restoration replacement [1, 2, 3]. The second most common reason is partial or complete fracture of the composite restoration. One of the most common reasons for secondary caries is bacterial biofilm (plaque) development at the tooth-filling interface which can lead to demineralization of tooth tissue due to acidic by-products of bacteria in plaque [4, 5] (ex. *Streptococcus mutans*).

The purpose of the study is to determine if bioactive glass (BAG) filled restorative composites maintain adequate mechanical properties when aged in a simulated oral environment containing bacteria, and if they have antimicrobial properties.

Methods: BAG (65%SiO₂, 31%CaO and 4%P₂O₅ mol%) containing samples were produced using a resin matrix BisGMA:TEGDMA with constant 72wt% total filler but varying BAG content from 5–15% with the balance being strontium glass. Control samples were also produced with 67%Sr-glass+5%OX50 silica.

Lyophilized cultures of *streptococcus mutans* (ATCC 25175) were grown in BHI media at 37°C. Inoculum was placed into cryotubes with particulate BAG and incubated aerobically for 1, 2 or 4hrs at 37°C. Viable colony counts were determined by serial dilution in reduced transfer fluid and plating onto BHI agar plates with aerobic incubation for 48hrs at 37°C.

Compact tension and bending beams samples were made by light-curing the composite from both sides (Triad II) in molds. Flexure strength, fracture toughness and fatigue crack growth were evaluated after two different aging treatments: 1) 24 hours in deionized water and 2) 60 days in trypticase soy agar broth with *streptococcus mutans* bacteria. Results were compared to a commercial composite (Heliomolar) using ANOVA/Tukey's test ($\alpha=0.05$).

Results: BAG fillers showed a lower viable colony count than the control (0%BAG) (Fig.1) and the composites had significantly improved mechanical properties over Heliomolar for both aging treatments. BAG composites were toughened by enhanced crack deflection and crack bridging far behind the crack tip giving superior performance over Heliomolar. Aging (24h vs. 60 days) had no significant effect on flexural strength of either material. Sixty days soaking decreased fracture toughness

of Heliomolar, 5%BAG, and 10%BAG (Fig.2) and softened the matrix of all samples based on the crack growth data, however, BAG retained superiority over Heliomolar.

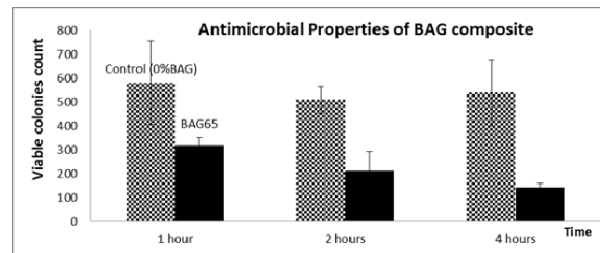


Fig.1 Antimicrobial Properties of BAG composite

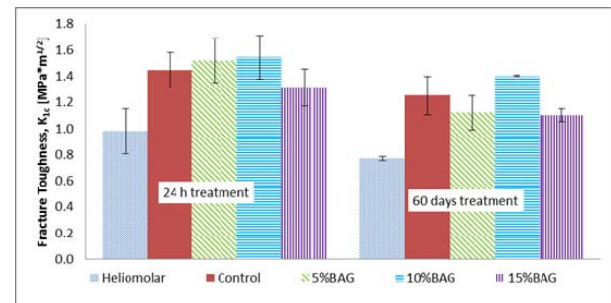


Fig.2 Fracture toughness for different soaking treatments

Conclusions: Dental composites containing BAG have antimicrobial characteristics and adequate mechanical performance, and stability for dental restorations.

References:

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