

Modifications in Dental Adhesives by the Addition of Nanoscale Polymeric Particles

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Objectives: Water absorbed into dental adhesives may cause phase-separation, decreasing mechanical properties/bond strengths. This study evaluates optical/mechanical properties of model adhesives to determine phase structure and mechanical properties as a function of water content.

Methods and Materials: BisGMA and hydroxyethyl-methacrylate (60:40wt%) were mixed with ethanol (10, 15 or 20wt%). Saturation (SAT) and 10% undersaturation (UN) concentrations of water were determined by light transmission reduction (LTR) in an optical bench (control-CON: no water). 0.2wt% camphorquinone/0.6wt%Ethyl-4-N,N-Dimethylaminobenzoate were the initiators. LTR was followed during polymerization in bars (2x2x25mm), later tested in three-point bending. Conversion (DC) was determined by FT-IR. Data was analyzed with two-way ANOVA/Tukey's test ($\alpha=5\%$).

Results: Water required for resin saturation increased with ethanol concentration (14.5, 17.2 and 19.1wt%, for increasing ethanol content). Controls did not show appreciable LTR, except at 20% ethanol (50 \pm 15%). LTR for SAT polymerizations was: 40 \pm 1, 14 \pm 6 and 8 \pm 2% for increasing ethanol content. Same superscript within the same test indicates statistically similarity.

Ethanol	Flexural strength-MPa			Modulus-GPa			DC-%		
	CON	UN	SAT	CON	UN	SAT	CON	UN	SAT
10%	60.0 \pm 3.6 a	29.2 \pm 3.0 d	32.6 \pm 2.9 c	1.7 \pm 0.2 ^a	0.7 \pm 0.0 ^d	0.9 \pm 0.0 ^c	96.4 \pm 0.3 ab	95.5 \pm 0.7 ab	96.6 \pm 0.5 ab
15%	38.5 \pm 2.9 b	08.1 \pm 2.0 d	08.0 \pm 0.7 d	1.1 \pm 0.0 ^c	0.2 \pm 0.0 ^e	1.3 \pm 0.2 ^b	97.7 \pm 0.2 a	87.1 \pm 2.1 c	85.5 \pm 2.8 c
20%	33.7 \pm 2.6 bc	04.8 \pm 2.1 d	05.7 \pm 1.4 d	1.0 \pm 0.0 ^c	0.1 \pm 0.0 ^e	0.1 \pm 0.0 ^e	97.8 \pm 0.2 a	89.6 \pm 7.4 bc	72.3 \pm 6.6 d

Conclusions: The amount of water required to saturate the less hydrophilic materials (10% ethanol) was lower. For those, phase separation during polymerization was greater, as was the decrease in mechanical properties. Next steps will include testing materials modified by the addition of hydrophobic nanogel particles. Supported by: NIH/NIDCR RC1DE020480.