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Dynamic monitoring of curing photoactive resins: A methods comparison.

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Abstract

OBJECTIVE: The aim of this investigation was to determine reaction enthalpy, ion viscosity and curing light transmission changes of unfilled methacrylate-based systems in order to compare methods that monitor photoactive resin polymerization. **METHODS:** Photoinitiator (0.2%, w/v, camphoroquinone), accelerator (0.3%, w/v, amine) and inhibitor (ranging from 0 to 1%, w/v, butylated hydroxytoluene, BHT) were incorporated in an experimental BisGMA/TEGDMA co-monomer mixture (50/50, w/v). The concentration of BHT was varied from 0.00, 0.01, 0.05, 0.10, 0.50 to 1.00% (w/v). Light transmission (LT), reaction enthalpy (UV-differential scanning calorimetry, DSC), and ion viscosity (dielectrical analysis, DEA) were determined during irradiation of the resins (40s; halogen light curing-unit). Statistical analysis was performed using two-way ANOVA followed by post hoc tests ($\alpha=0.05$). Curve fitting and regression calculation were done. **RESULTS:** There was no significant change in the time to reach the maximum rate of polymerization (reaction time) in the individual systems up to a BHT concentration of 0.05% ($P>0.05$). Starting at a concentration of 0.10% BHT an increase in time of reaction could be found from 4.0s (LT), 4.07s (DEA) and 4.9s (DSC) to a maximum of 7.4s (DSC), 9.43s (DEA) and 9.67s (LT). Linear increase ($y=5.588xx$) in time to the maximum speed of reaction could be found with a correlation of $R(2)=0.992$. **CONCLUSIONS:** The speed of polymerization reaction is strongly influenced by BHT concentration. The linear relationship should allow for the prediction of the speed of reaction during blending of a methacrylate-based resin. The three test systems allow for monitoring the complex polymerization kinetics of unfilled methacrylate-based systems. Copyright © 2010 Academy of Dental Materials. Published by Elsevier Ltd. All rights reserved.