COMMENTARY

TEMPERATURE CHANGES IN SILORANE-, ORMOCER-, AND DIMETHACRYLATE-BASED COMPOSITES AND PULP CHAMBER ROOF DURING LIGHT-CURING

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The organic resin matrix of composite resins has remained essentially unchanged since the pioneering work of Bowen in the 1960s. Nearly all composites contain dimethacrylates such bisphenol A glycidyl methacrylate (bis-GMA) that polymerize via free-radical addition polymerization. The authors evaluated a recently introduced composite resin material, Filtek LS (3M ESPE, St. Paul, MN, USA), which is based on silorane resin—a fundamental change in resin matrix chemistry.[1] The silorane ring-opening monomer reportedly provides lower polymerization shrinkage.[1,2] Filtek LS also incorporates a unique three-component initiator system, which requires a minimum curing time of 20 seconds, irrespective of the irradiance of the curing light.[1] The authors emphasize that studies have shown that cationic ring-opening reactions of oxiranes, a building block of siloranes, are highly exothermic.

The purpose of this study was to evaluate temperature changes of a new silorane and two traditional dimethacrylate composite resin restorative materials at the bottom surface of the material and at the roof of the pulp chamber when polymerized with a light-emitting diode (LED) curing light. The heat generated by photopolymerization of composite resin materials can potentially damage pulpal tissues from a combination of both the light source and exothermic reaction.[3] And although the authors found a significantly higher increase in temperature at the bottom of the new silorane material, there was no significant difference in temperatures between any of the composites tested when measured at the roof of the pulp chamber. The 1-mm-thick dentin provided significant insulation of the pulpal chamber. Although the authors standardized the remaining dentin thickness in this study, it is very difficult to predict the temperature rise clinically in any particular tooth because of multiple variables such as preparation depth, remaining dentin thickness, output intensity of the curing light, exposure time, composition, shade, and thickness of composite.

Recently, newer LED curing lights have been marketed with increasingly higher output intensities, approaching the 2,000 mW/cm^2 irradiance seen with high-powered plasma arc lights. Using a temperature-compensated, fluid-flowing tooth model and various commercial dental curing lights (LED, plasma arc, halogen), a recent study by Rueggeberg and colleagues found a direct, linear correlation between intrapulpal temperature rise and increased curing light irradiance when measured in the pulp chamber of a human bicuspid with a Class V preparation and 1 mm of remaining dentin thickness.[4] In clinical situations, the rise in pulpal temperature is reduced by dentin thickness, fluid motion in the dentinal tubules, blood circulation in the pulp chamber, and heat convection by the surrounding periodontal tissues.[3] The actual critical temperature necessary to cause pulpal damage is controversial; however, pulpal temperature changes should be kept as minimal as possible. Clinicians should be aware of the irradiance of their curing lights and adjust their curing times appropriately to minimize the potential hazard to the pulp that might result from visible light-curing, especially with the newer, high-powered units.

REFERENCES

1. Filtek LS. Technical Product Profile. St. Paul (MN): 3M ESPE. Available at: http://www.3m.com (accessed November 12, 2008).
2. Palmer TM, Gessel TF, Christensen CC, et al. Volumetric shrinkage of “low shrinkage” composite resins. J Dent Res 2005;84: Spec Issue, abstract #0296. Available at: http://www.dentalresearch.org (accessed November 12, 2008).
3. Ozturk B, Ozturk AN, Usumez A, et al. Temperature rise during adhesive and resin composite polymerization with various light curing sources. Oper Dent 2004;29:325–32.
4. Rueggeberg FA, Moss L, Herrin BE, Cox RJ. Correlation of power density with simulated in-vitro intrapulpal temperature rise. J Dent Res 2008;87: Spec Issue, abstract #0990. Available at: http://www.dentalresearch.org (accessed November 12, 2008).

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