

RESEARCH ARTICLE

Depth-of-cure of Bulk-fill Composites Cured in Tooth or Opaque Substrate

¹Brent W Church, ²Darane Tanthrojn, ³Thuydung Do, ⁴Martha H Wells, ⁵Antheunis Versluis

ABSTRACT

Purpose: To determine the effect of substrate on the depth-of-cure determination when using hardness profiles in a covered-slot technique and to introduce a new covered-slot method that uses tooth substrates.

Materials and methods: Three bulk-fill composites and one conventional composite were tested: Tetric EvoCeram Bulk Fill, Venus Bulk Fill, Filtek Bulk Fill Flowable, Filtek Supreme Ultra. The composites were light-cured in rectangular slots (2 mm deep, 2 mm wide) made in a plaster mold or an extracted tooth. The slots were covered with an orange glass plate during curing, leaving one end exposed for light-curing. After curing, the glass plate was removed and the sample was stored in the dark for 24 hours before Vickers hardness was measured as a function of depth at 0.5-mm intervals. Results were analyzed using two-way analysis of variance (ANOVA) and pairwise comparisons (significance level 0.05).

Results: The hardness of composites cured in covered-slot molds decreased with increasing depth ($p < 0.001$). Bulk-filled composites cured in plaster molds had a slightly lower depth-of-cure than those cured in natural tooth substrates. Differences between the tooth and plaster substrates were significant at all depths in the "packable" bulk-fill composite (Tetric EvoCeram Bulk Fill), and were significant at ≥ 2.5 and ≥ 3.5 mm in the flowable bulk-fill composites (Filtek Bulk Fill Flowable and Venus Bulk Fill) respectively.

Conclusion: Using natural tooth substrates in the covered-slot method increased the depth-of-cure of bulk-filled composites in comparison to opaque plaster molds.

Keywords: Bulk-fill, Composite, Depth-of-cure, Hardness, Tooth.

How to cite this article: Church BW, Tanthrojn D, Do T, Wells MH, Versluis A. Depth-of-cure of Bulk-fill Composites Cured in Tooth or Opaque Substrate. *Int J Experiment Dent Sci* 2017;6(2):68-73.

^{1,3}Private Practitioner, ²Professor, ⁴Associate Professor and Director, ⁵Professor and Director

¹Department of Pediatric Dentistry, Prairie Village, Kansas, USA

²Department of Restorative Dentistry, University of Tennessee Health Science Center, Memphis, Tennessee, USA

³Department of Pediatric Dentistry, Arlington, Texas, USA

⁴Department of Pediatric Dentistry, University of Tennessee Health Science Center, Memphis, Tennessee, USA

⁵Department of Bioscience Research, University of Tennessee Health Science Center, Memphis, Tennessee, USA

Corresponding Author: Antheunis Versluis, Professor and Director, Department of Bioscience Research, University of Tennessee Health Science Center, Memphis, Tennessee, USA
Phone: +19014486372 e-mail: antheun@uthsc.edu

Source of support: Supported by the University of Tennessee Health Science Center College of Dentistry Alumni Endowment Fund and the Tennessee Dental Association Foundation.

Conflict of interest: None

INTRODUCTION

Light-curing composite resins are one of the most widely used restorative dental materials. The placement of composite restorations is technique-sensitive and requires adequate light curing to ensure a thorough cure.¹⁻³ Function and longevity of the restoration will be compromised if the composite is not sufficiently cured.⁴ Therefore, when restoring cavities with light-activated resin composites, it is recommended to cure the resin composite in increments no thicker than 2 mm to ensure an adequate cure.¹⁻³ In order to overcome the 2 mm incremental composite placement limitation and thus decrease chair time, several manufacturers have introduced "bulk-fill" composites. These composites claim to cure adequately up to 4 mm deep, and hence, restorations can be filled in one increment ("bulk") when the cavity depth is less than 4 mm.⁵⁻⁷ Research studies have shown mixed results: Some studies confirmed the manufacturers' claims while other studies found inadequate curing when cured in 4-mm bulk.⁸⁻¹⁵ Since adequate polymerization of the composite is critical to the success of the restoration, evaluation of the depth-of-cure of composites remains a vital topic in dental research.

The inconsistency in the literature regarding the depth-of-cure of bulk-filled composites can be a result of specific products or can be caused by methodology used for the measurements. Low-viscosity bulk-fill composites cure deeper than high-viscosity materials.^{3,15-17} The same composites showed different depth-of-cure when measured with different methods. A scraping test [International Organization for Standardization (ISO) 4049]¹⁸ overestimated the depth-of-cure compared with hardness tests, because partially cured material is usually rigid enough to be considered "cured".^{3,8,12,19} A note in the 1992 ISO publication alludes to this observation by suggesting that the obtained depth-of-cure is about twice the optimal conversion of monomer or polymer.¹⁸ Hardness values represent load-bearing ability and have been correlated with the degree of conversion for resin materials.^{20,21} Hardness can be determined as the top/bottom hardness ratio at prescribed depths^{3,10-12,14,15,19} or