Objective

In recent years, bulk fill composites have been introduced to the market claiming that they could be placed in bulk up to 4 or 5 mm thick layers, avoiding the layering techniques, while allowing adequate polymerization. The aim of this in vitro study was to investigate the degree of conversion (DC%), depth of cure (DPC) and microhardness (MH) of a dual-curing bulk-fill composite compared to light-curing ones in deep simulated cavities.

Materials and Methods

Materials tested were Fill-Up! (Coltene), a dual-curing bulk-fill material, and three photocuring bulk-fill composites: SDR (Dentsply), SonicFill (Kerr) and Tetric EvoCeram BF (Ivoclar). Flat dentin surfaces were obtained from extracted non-caries human molars. A cylindrical mold (height: 8 mm; diameter: 5 mm) obtained from a putty polyvinylsiloxane impression material was positioned on the dentin surface. After application of the adhesive system (ParaBond, Coltene), composites were placed into the mold in bulk and polymerized for 20 s with a LED curing light (Coltolux SPEC3, Coltene) from the top of the cylinder. After 24 h molds were removed and composite cylinders were sectioned perpendicularly to the top surface to expose the composite depth. Micro-Raman spectra of the specimens were collected using a Raman equipment (Renishaw InVia) at 1 mm intervals from the bottom to the composite surface. Spectra were acquired over the spectral region of 400 to 1900 cm⁻¹. Micro-Raman spectra of the uncured and cured composites were collected to identify reference and reaction peaks [605 cm⁻¹ (C=O-O); 1610 cm⁻¹ (aromatic ring); 1640 cm⁻¹ (C=C group)]. DC % was calculated using the ratio between reactive and internal reference peak intensities. MH assessment was measured on the same specimens analyzed with micro-Raman at 1 mm intervals from the bottom to the composite surface with a Vickers microhardness tester (Leica Microsystems) at a 200 g load for 10 s. Data were statistically analyzed with Kruskal-Wallis and Mann-Whitney tests.

Results

Results are summarized in Table 1. Fill-Up!, Tetric EvoCeram BF and SDR showed an adequate DC% at all depths, but MH significantly decreased at higher depths for all materials except for Fill-Up!, which was the only composite with a comparable MH at all depths. SonicFill could not be polymerized beyond 6 mm.

Conclusions

Within the limits of this experimental design, DC%, DPC and MH of bulk-fill composites were material-dependent. All materials could be polymerized for more than 5 mm. Fill-Up!, thanks to its dual-curing formulation, was the only material showing a uniform DC%, DPC and MH at all depths. SonicFill was the only tested composite that could not be polymerized up to 8 mm, with a mean maximum depth of cure of 6 mm.

References