ISSN Print: 2394-7489
ISSN Online: 2394-7497
IJADS 2019; 5(4): 219-221

www.oraljournal.com
Received: 08-08-2019
Accepted: 10-09-2019

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To assess depth of cure and hardness of bulk-fill composites

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Abstract
Background: The increased usage of direct chair-side application of resin composite for restoring cavities in the anterior and posterior dentition has continued despite their technique sensitivity and limited depth of cure. The present study was conducted to assess depth of cure and hardness of bulk-fill composites.
Materials & Methods: The present *in vitro* study was conducted in department of Endodontics. It comprised of 3 RBC material-Tetric N-Ceram bulk fill (TNCBF), Tetric Evoflow bulk fill (TEFBF) and Surefil SDR bulk-fill (SDRBF). Hardness of materials was estimated in all materials.
Results: Materials used in the study was Tetric N-Ceram bulk fill (TNCBF), Tetric Evoflow bulk fill (TEFBF) and Surefil SDR bulk-fill (SDRBF) were placed in group I, II and III respectively. The mean hardness value of group I material at top was 45.2 and at bottom was 32.5, in group II at top was 41.0 and at bottom was 33.6, in group III at top was 38.2 and at bottom was 34.1. The difference was significant ($P< 0.05$).
Conclusion: Authors found that hardness value of Tetric N-Ceram bulk fill material was highest among all restorative materials.

Keywords: Tetric N-Ceram bulk fill, Tetric Evoflow bulk fill, Surefil SDR bulk-fill

Introduction
The increased usage of direct chair-side application of resin composite for restoring cavities in the anterior and posterior dentition has continued despite their technique sensitivity and limited depth of cure [1]. When restoring deep or large cavities in the posterior dentition, an incremental filling process which includes repetitive placement and photo polymerization of resin composite is often required. However, using this technique is time consuming and also there is probability of air bubbles confinement or contamination between layers of the composite [2].
While restoring cavities, especially deep ones, with 2-mm thick increments, a risk of incorporating air bubbles or failure to maintain adequate isolation leads to contaminations between the increments reduced mechanical properties of RBC restorations. In addition to increased clinical time and technical complexities, other disadvantages of the incremental filling technique include reduced bond strengths as well as voids, contamination, and bond failures between adjacent RBC layers [3]. With advances in polymer chemistry, photo-activation, and curing light technologies, a new "class" of RBCs called bulk-fill composites have emerged, that enable the restoration to be placed in 4–5 mm thick layer and cured easily and thus replacing both enamel and dentin [4]. The placement of larger increments of RBC may reduce the time needed when placing posterior restorations and thereby reduce technique sensitivity. Bulk-fill composites are available as low-viscosity flowable, for example, Surefil SDR (Dentsply Caulk) and high-viscosity restorative, for example, Tetric–N-Ceram Bulk fill (Ivoclar Vivadent, Amherst, NY) materials and dual-cure bulk fill, for example, Fill-Up [5]. The present study was conducted to assess depth of cure and hardness of bulk-fill composites.

Materials & Methods
The present *in vitro* study was conducted in department of Endodontics. Ethical approval was obtained prior to the study. It comprised of 3 RBC material-Tetric N-Ceram bulk fill (TNCBF), Tetric Evoflow bulk fill (TEFBF) and Surefil SDR bulk-fill (SDRBF).

An opaque acrylic resin mold with a hole of 4.5 mm height and 6.5 mm diameter was prepared. The mold was placed on a glass slide covered with a Mylar strip, and then the composite was filled in bulk for each material. Other Mylar strip and glass slide were placed on top, and excess material was pressed out. The specimen was polymerized for 20s, keeping the tip of the cordless Bluephase LED light-curing unit (Ivoclar Vivadent) in contact with the glass slide (1.2-mm thick) to ensure a constant distance from the specimen. All light-curing procedures were performed with the same curing unit operating in a continuous mode while emitting a light-intensity of 1100 mW, maintained at full charge before use, and irradiance was checked periodically with a radiometer (Bluephase Meter II, Ivoclar Vivadent).

In all specimens, hardness was assessed using vickers microhardness instrument.

The DOC is the thickness of the composite that is adequately polymerized or rather as the depth where HV equals the surface value multiplied by an arbitrary ratio, usually 0.8 (HV - 80%), was calculated. Results thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

Results

Table 1: Distribution of materials

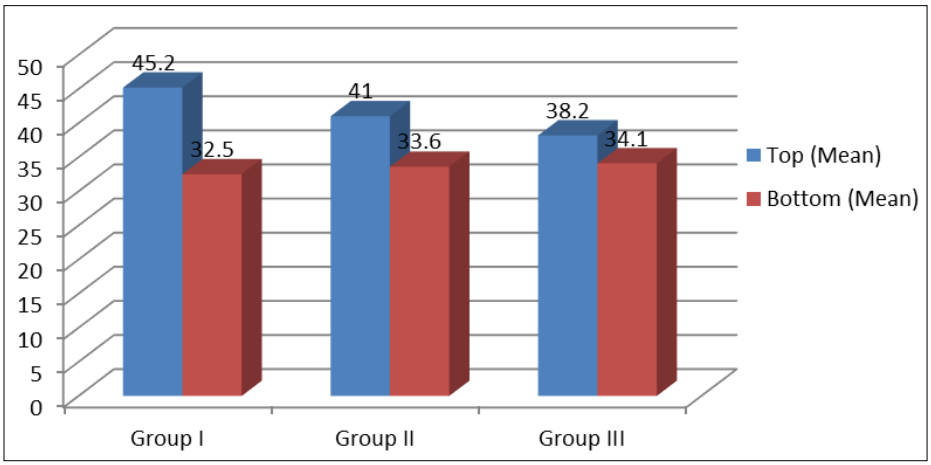
Group I	Group II	Group III
Tetric N-Ceram bulk fill (TNCBF)	TetricEvoflow bulk fill (TEFBF)	Surefil SDR bulk-fill (SDRBF)

Table I shows that materials used in the study was Tetric N-Ceram bulk fill (TNCBF), Tetric Evoflow bulk fill (TEFBF) and Surefil SDR bulk-fill (SDRBF) were placed in group I, II and III respectively.

Table 2: Comparison of hardness of materials

Groups	Top (Mean)	Bottom (Mean)	P value
Group I	45.2	32.5	0.01
Group II	41.0	33.6	
Group III	38.2	34.1	

Table II, graph I shows that mean hardness value of group I material at top was 45.2 and at bottom was 32.5, in group II at top was 41.0 and at bottom was 33.6, in group III at top was 38.2 and at bottom was 34.1. The difference was significant ($P< 0.05$).



Graph 1: Comparison of hardness of materials

Discussion

Manufacturers claim that the bulk-fill composite materials can be cured up to a depth of 4 to 5 mm. The increased depth of cure may be achieved through the use of novel proprietary resins, special modulators and unique fillers [6]. The higher light transmission properties of the bulk fill composite is due to reduction of light scattering at the filler–matrix interface by either decreasing the filler amount or increasing the filler size. Moreover, differences in the refractive indices between the fillers and the organic matrix of the RBC materials also affect their translucency [7]. The present study was conducted to assess depth of cure and hardness of bulk-fill composites.

In present study, materials used in the study was Tetric N-Ceram bulk fill (TNCBF), Tetric Evoflow bulk fill (TEFBF) and Surefil SDR bulk-fill (SDRBF). We found that mean hardness value of group I material at top was 45.2 and at bottom was 32.5, in group II at top was 41.0 and at bottom was 33.6, in group III at top was 38.2 and at bottom was 34.1. The difference was significant ($P< 0.05$). Alkhudhairy *et al.* [8] evaluated depth of cure, the composite specimen was prepared using metallic mold with a hole of 4 mm depth and 4 mm internal diameter which was bulk filled with each of the three bulk fill composites (SonicFill, Filtek Bulk Fill Posterior & Beautifil Bulk Restorative) and light cured for 20 seconds. The conventional composite (Tetric N Ceram) was filled in the increments of 2-mm. The top and bottom surface hardness was measured using a Vickers microhardness indenter. The depth of cure was then calculated by dividing the bottom & top mean hardness values. Sonicfill showed maximum surface microhardness followed by Beautifil Bulk restorative, Tetric N Ceram and Filtek Bulk Fill. Maximum depth of cure was seen in SonicFill followed by Filtek Bulk Fill, Tetric N Ceram and Beautifil Bulk restorative and the difference was statistically significant. SonicFill and Filtek Bulk Fill were able to achieve the minimum depth of cure value ≥0.80 at 4-mm depth. Beautiful bulk restorative composite was not able to achieve the minimum bottom to top ratio of 0.80.

Tarle *et al.* [9] conducted a study in which a standardized polyacrylic mold was bulk filled with each of the six composites and light-cured for 20 s, followed by 24 h storage in water. The surface hardness was measured on the top and the bottom by recording Vickers hardness number by Vickers hardness indenter. The mean bottom surface hardness value (HV) of SDR and TEFBF exceeded 80% of the top surface HV (HV-80%). Low viscosity bulk-fill composites (SDR and Tetric Evoflow) were properly cured in 4-mm increments.

The TNCBF, high-viscosity composite, and Fill-Up, dual-cure bulk fill were not sufficiently cured in 4-mm increments.
With increase in incremental thickness, HV decreased for the conventional resin composite but generally remained constant for the bulk-fill resin composites.
Kelić *et al*. [10] investigated the mechanical properties of different types of nanohybrid bulk fill composites also showed similar results and concluded that SonicFill system had the highest score among the tested materials and can be used as an alternative to regular composite for posterior teeth restoration.

Conclusion

Authors found that hardness value of Tetric N-Ceram bulk fill material was highest among all restorative materials.

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