

## Original Research

### An in vitro study to evaluate depth of cure of bulk-fill composites – A comparative Study

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#### ABSTRACT:

**Background:** Resin-based composites (RBCs) are now considered as a material of choice restorative dental materials. The insertion of composite resins into the cavities demand adequate curing with light cure gun. The present study was conducted to assess depth of cure of bulk-fill composites. **Materials & Methods:** The present invitro study was conducted in the department of endodontics. It comprised of four RBC material-Tetric N-Ceram bulk fill (TNCBF), Tetric Evoflow bulk fill (TEFBF), surefil SDR bulk-fill (SDRBF) and fill-Up Dual cure bulk fill (FUDBF). Ethical clearance was obtained from institutional ethical committee. The surface hardness was measured on the top and the bottom by recording Vickers hardness number by Vickers hardness indenter. **Results:** The hardness value of 41.8, 39.7, 39.2 and 45.3 in group I, II, III and IV respectively at top. At bottom, it was 30.7, 32.5, 34.2 and 34.5 in group I, II, III and IV respectively. Bottom to top ratio was 0.71, 0.73, 0.82 and 0.85 in group I, II, III and IV respectively. **Conclusion:** Authors found that maximum bottom to top ratio hardness value was maximum with Surefil SDR bulk-fill and Fill-up dual cure bulk fill composite resins.

**Key words:** Surefil SDR, Fill-up dual cure bulk fill composite, depth of cure

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#### INTRODUCTION

Resin-based composites (RBCs) are now considered as a material of choice restorative dental materials. The insertion of composite resins into the cavities demand adequate curing with light cure gun.<sup>1</sup> It has proved to be boon in the field of conservative and esthetic dentistry. Major advantages are better mechanical properties, easy handling and its capability to copy the natural appearance of teeth.<sup>2</sup> Thus one can say that it is a technique-sensitive procedure. The success of composite resins is based on adequate light-curing to ensure proper function and longevity of the restoration. The placement of composite material into the cavities in increments of 2 mm is regarded as the gold standard.<sup>3</sup> The mechanical, physical, biological and esthetical properties of composites have improved a lot over

couple of years.<sup>4</sup> Resin based composite can be easily used as posterior restorations in place of amalgam. Bulk fill Resin composites are very effective in avoiding incorporating voids and contamination between layers. It has also found that cuspal deflection and marginal integrity are better than standard composites.<sup>5</sup> According to the manufacturer's claims bulk fill composites can be applied up to 4 mm, or even 5 mm in one time. Bulk-fill composites contain low amount of enlarged filler. Thus, bulk-fill composites should have minimized polymerization shrinkage, a reasonable depth of cure (DOC), flowable enough to reach all the areas of the preparation without creating voids.<sup>6</sup> Thus the present study was conducted to assess depth of cure of bulk-fill composites.

**MATERIALS & METHODS**

The present in vitro study was conducted in the Department of Conservative Dentistry and Endodontics, Institute of Dental Sciences, Sehora, Jammu. It comprised of four RBC material-Tetric N-Ceram bulk fill (TNCBF), Tetric Evoflow bulk fill (TEFBF), surefil SDR bulk-fill (SDRBF) and fill-Up Dual cure bulk fill (FUDBF). Ethical clearance was obtained from institutional ethical committee. Based on different materials, 4 groups were made. Group I had Tetric N-Ceram bulk fill, group II had

tetric evoflow bulk fill, group III had surefil SDR bulk-fill and group IV had fill-up dual cure bulk fill. A standardized polyacrylic mold was bulk filled with each composites and light-cured for 20 seconds, followed by 24 hours storage in water. The surface hardness was measured on the top and the bottom by recording Vickers hardness number by Vickers hardness indenter. Results thus obtained were subjected to statistical analysis. P value less than 0.05 was considered significant (P< 0.05).

**RESULTS**

**Table I Distribution of materials**

Groups	Group I	Group II	Group III	Group IV
Materials	Tetric N-Ceram bulk fill	Tetric Evoflow bulk fill	Surefil SDR bulk-fill	Fill-up dual cure bulk fill
Number of sample	15	15	15	15

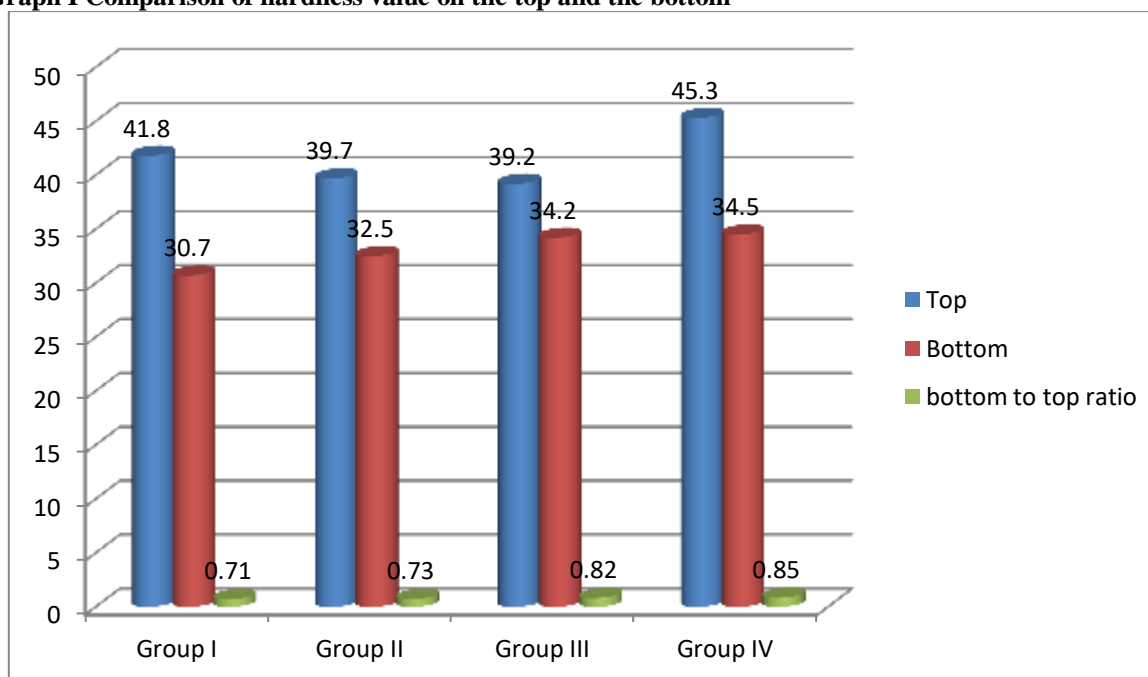
Table I shows distribution of different resin based composites in 4 groups.

**Table II Comparison of hardness value on the top and the bottom**

Groups	Top	Bottom	bottom to top ratio
Group I	41.8	30.7	0.71
Group II	39.7	32.5	0.73
Group III	39.2	34.2	0.82
Group IV	45.3	34.5	0.85

Table II, graph I shows hardness value of 41.8, 39.7, 39.2 and 45.3 in group I, II, III and IV respectively at top. At bottom, it was 30.7, 32.5, 34.2 and 34.5 in group I, II, III and IV respectively. Bottom to top ratio was 0.71, 0.73, 0.82 and 0.85 in group I, II, III and IV respectively.

**Graph I Comparison of hardness value on the top and the bottom**



## DISCUSSION

Bulk flow composites are available as low-viscosity flowable such as 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 (ColteneWaledent).<sup>7</sup> The DOC and degree of conversion (DC) of bulk-fill RBCs have been studied with different methods. These include the ISO scraping test, microhardness test, Fourier-transform infrared, and Raman spectroscopy. Since hardness measurement has been shown to be a practical method to indirectly determine DC for a given resin composite, hardness profiles can be used to measure DOC.<sup>8</sup> We found that Group I had Tetric N-Ceram bulk fill, group II had tetric evoflow bulk fill, group III had surefil SDR bulk-fill and group IV had fill-up dual cure bulk fill. Aggarwal et al<sup>9</sup> compared the depth of cure of RBC's for posterior use: Sculptable bulk-fill composite – Tetric N-Ceram bulk fill (TNCBF), Flowable bulk-fill composites-Tetric Evoflow bulk fill (TEFBF), Surefil SDR bulk fill (SDRBF), Dual cure bulk fill-Fill-Up (FDCBF) with conventional RBC-Esthet-X flow (EXF) and Filtek Z250 (FZ). 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.

In our study, hardness value of 41.8, 39.7, 39.2 and 45.3 in group I, II, III and IV respectively at top. At bottom, it was 30.7, 32.5, 34.2 and 34.5 in group I, II, III and IV respectively. Bottom to top ratio was 0.71, 0.73, 0.82 and 0.85 in group I, II, III and IV respectively. Yokesh et al<sup>10</sup> evaluated the degree of conversion of the same composite resins with Fourier Transform Infrared (FTIR) spectroscopy method. Composite resin specimens (n=10) per group were prepared with bulk fill flowable composites, Surefil SDR flow designated as Group A and Filtek bulk fill designated as Group B. The mean depth of cure of Group A was 3.89 mm ( $\pm 0.103$ ) and for Group B was 3.54 mm ( $\pm 0.129$ ). The degree of conversion percentage for Group A1=78.51 ( $\pm 47.8$ ), Group A2=31.9 ( $\pm 22.4$ ), Group B1=39.8 ( $\pm 5.2$ ), Group B2=37.4 ( $\pm 6.4$ ). Statistical analysis revealed significant difference in the depth of cure between the two bulk fill flowable composites with Group A higher than Group B. The degree of conversion of the coronal half of Group A1 was significantly higher when compared to Group B1.

Depth of cure is defined as the depth to which the light is able to cure the material. The use of thicker increments in bulk-fill resin composites is due to both developments in photoinitiator dynamics and their increased translucency, which allows additional light penetration and a deeper cure. DOC is dependent on filler (type, size, and load), light irradiance, exposure

time, radiant exposure, and also resin composition and shade.<sup>11</sup>

Cetin et al<sup>12</sup> in their study found that there were statistically significant differences between different bulk fill composite materials in terms of max. VHN and depth of cure, corresponding to 80% of max. VHN. Depth of cure is related to the clinical success of restoration. When a more extensive polymerization and crosslinking occurs, greater VHN results are obtained. According to the manufacturer's claims bulk fill composites can be applied up to 4 mm, or even 5 mm in one time.

## CONCLUSION

Authors found that maximum bottom to top ratio hardness value was maximum with Surefil SDR bulk-fill and Fill-up dual cure bulk fill composite resins.

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