Bulk-Fill Flowable Composite Resins

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Recent developed flowable composite resins have been marketed for bulk filling of preparations or replacement of dentin in a single increment. The obvious attraction of these materials—quicker placement of restorations—has rapidly made them very popular despite the limited in vitro data and lack of clinical studies. This Critical Appraisal will review some of the available in vitro literature on the topic and summarize the available knowledge in this new category of restorative materials.

Marginal Quality of Flowable 4-mm Base versus Conventionally Layered Resin Composite

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ABSTRACT

Objective: To evaluate the in vitro marginal and internal adaptations of Class II composite restorations performed with SureFil Stress Decreasing Resin (SDR) Flow (Dentsply DeTrey, Konstanz, Germany).

Materials and Methods: Standardized Class II mesio-occluso-distal (MOD) preparations with mesial and distal gingival margins in enamel and dentin, respectively, were prepared. Internal angles were rounded and no bevels were placed. The prepared teeth were randomly assigned to five groups to be treated with different adhesives. The restorative procedure consisted of placement of a metal matrix band, application of the adhesive, buildup of dentin with a 4-mm SureFil SDR Flow (SDR) increment, and replacement of enamel with regular composite resin. A composite resin from the same manufacturer of the adhesive was used for enamel replacement. Control groups used each manufacturer's products (adhesive and composite resin), with the composite resin applied incrementally and without the use of SDR. All light-curing procedures were performed with a Translux CL light-curing unit (Heraeus Kulzer, Hanau, Germany). Restorations were finished with Sof-Lex discs (3M ESPE, Seefeld, Germany and St. Paul, MN, USA). Restored teeth were subjected to thermomechanical loading (TML) to mimic oral conditions. Pre- and post-TML impressions were taken for scanning electron microscopy (SEM) evaluation of marginal adaptation. Teeth also were sectioned mesiodistally for SEM evaluation of internal adaptation.

Results: Prior to TML, groups restored with or without SDR that had been previously treated with the adhesives XP Bond (Dentsply DeTrey), Syntac (Ivoclar Vivadent, Schaan, Liechtenstein), and Prompt L-Pop (3M ESPE), and subsequently restored with the composite resins Ceram X-Mono (Dentsply DeTrey), Tetric EvoCeram (Ivoclar Vivadent), and Filtek Supreme XT (3M ESPE), respectively, had gap-free enamel margins. Significant

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differences were found when comparing those with iBond SE/Venus Diamond (Heraeus Kulzer) and Xeno IV/Ceram-X Mono (Dentsply DeTrey). These showed defects in approximately 10 and 3% of the enamel margins, respectively, despite the use of SDR. Gap-free enamel margins were found when Xeno IV/Ceram-X Mono were used without SDR. In dentin, all materials showed no marginal gap except Prompt L-Pop, which presented defects in 6 to 8% of the margins. After TML, all adhesives had a decrease in marginal integrity. Etch-and-rinse adhesives (XP Bond and Syntac) outperformed self-etch adhesives in both enamel and dentin. SDR did not have any effect on enamel or dentin marginal integrity or on internal adaptation after TML. As for internal adaptation, etch-and-rinse adhesives had better internal adaptation than self-etch adhesives.

Conclusions: A 4-mm SDR base had no detrimental effects when compared with conventional composite resins placed without the flowable resin base.

COMMENTARY

This study compared the effects of several different adhesives used with each respective manufacturer's composite resin versus the same combination but with the addition of SDR. Although SDR did not improve the marginal integrity and internal adaptation of any combination of materials, it also did not have any adverse effect on them. Interestingly, etch-and-rinse adhesives outperformed self-etch adhesives in dentin after TML. Because of the comparable results between SDR and non-SDR groups, it can be speculated that the failures occurred at the dentin/adhesive interfaces, suggesting a weaker bond of self-etch adhesives to dentin. It is important to emphasize that restorations in the control groups were placed in two horizontal increments. The internal adaptation as well as marginal integrity could potentially be improved by using a more sophisticated incremental placement technique.

In Vitro Comparison of Mechanical Properties and Degree of Cure of Bulk-Fill Composites

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ABSTRACT

Objective: To compare mechanical properties and degree of conversion of two bulk-fill flowable composite resins (Venus Bulk Fill, Heraeus Kulzer; SureFil SDR Flow, Dentsply Caulk, Milford, DE, USA).

Materials and Methods: The degree of conversion, Vickers hardness, and indentation modulus of Venus Bulk Fill and SureFil SDR Flow (SDR) were measured as a function of depth and polymerization time. Flexural strength and modulus of elasticity also were evaluated. The degree of conversion of the composite resins was evaluated at 0.1-, 2-, 4-, and 6-mm (the latter in bulk or in 2-mm increments) depths when light-activated for 10, 20, or 40 seconds using an Elipar Freelight 2 (3M ESPE) light emitting (LED) curing device. The 6-mm bulk-filled specimens were used for determination of hardness and indentation modulus. Flexural strength and modulus of elasticity were determined in a three-point bending test. The size of the fillers in each composite resin was assessed with field emission scanning electron microscope (FE-SEM).

Results: Increased polymerization time increased the degree of conversion of 4- and 6-mm bulk increments for both composite resins. However, no improvement was noticed when the 6-mm bulk increments were polymerized for at least 20 seconds for Venus Bulk Fill and 40 seconds for SDR, compared to incrementally polymerized increments. When composite resins were compared, Venus Bulk Fill outperformed SDR, having a degree of conversion of approximately 5% higher for all

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irradiation times and depths. The most significant finding regarding hardness was that both composite resins reached a hardness value of 80% of the surface hardness at the depth of 6 mm. SDR had higher values for hardness and indentation modulus, and higher macromechanical properties values (flexural strength and modulus of elasticity) than Venus Bulk Fill. FE-SEM images showed SDR to have smaller particle fillers than Venus Bulk Fill.

Conclusions: SDR had better mechanical properties despite a lower degree of conversion than Venus Bulk Fill. Also, polymerization time of 20 seconds for 4-mm bulk placed increments of either material seems appropriate.

COMMENTARY

Results of this study revealed better properties for SDR than for Venus Bulk Fill. That was true despite its lower degree of conversion. It is worth noting that the study was performed in a laboratory setting with the light-curing unit very close to the material. That is unlikely to occur clinically, which may result in different properties and degree of conversion. According to the results of the present study, recommended irradiation times should suffice in providing adequate properties to the materials tested. Relevant properties are not compromised if the bulk-fill flowable composite resins are light-activated for at least 20 seconds when used in 4-mm increments.

Surface Roughness of Flowable Resin Composites Eroded by Acidic and Alcoholic Drinks

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ABSTRACT

Objective: To evaluate the surface roughness of flowable composite resins after exposure to acidic and alcoholic beverages.

Materials and Methods: The flowable composite resins SureFil SDR Flow (Dentsply Caulk), Tetric EvoFlow (Ivoclar Vivadent), Esthet-X Flow (Dentsply Caulk), and Amaris Flow (Voco, Cuxhaven, Germany) were studied. Thirty disks of each material were fabricated in plastic ring molds and polymerized with an Elipar TriLight (3M ESPE) halogen curing device. Specimens were subjected to artificial aging and then immersed in one of the following: (1) artificial saliva, (2) acidic soft drink (Coca-Cola, Italy), and (3) alcoholic drink (Chivas Regal, Aberdeen, Scotland, UK) for 14 days. Solutions were replenished daily until surface roughness measurement. pH of the solutions were 6.7, 2.6, and 4.2 for the artificial saliva, soda, and whisky, respectively.

Results: Among the solutions, Coca-Cola produced the highest roughness values. When the flowable composite resins were compared, SureFil SDR Flow (SDR) had overall higher surface roughness values than Tetric EvoFlow, Esthet-X Flow, and Amaris Flow. The difference between SDR and the other materials was significant, whereas there was no significant difference among the other three flowable composite resins. Analysis of the results per group showed that artificial saliva and Coca-Cola were more detrimental to SDR.

Conclusions: Exposure to acidic and alcoholic drinks as well as to artificial saliva affects the surface roughness of flowable composite resins.

COMMENTARY

The use of flowable composite resins in an open sandwich technique has been advocated by some clinicians, who believe that it will improve marginal adaptation of the restoration. To be successful with that technique, the flowable composite resin liner/base should have certain properties that will guarantee an adequate long-term performance. In a very extreme setup, the present study challenged some of those

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materials, which showed different results. Even though all specimens were supposedly prepared in the same manner, it would have been helpful to know the baseline surface roughness of each specimen for reference. Moreover, it would have been beneficial to know the effect of such solutions on enamel for comparison. Nevertheless, clinicians should be aware that flowable composite resins can be affected by extreme consumption of acidic and alcoholic beverages.

Cuspal Deflection and Microleakage in Premolar Teeth Restored with Bulk-Fill Flowable Resin-Based Composite Base Materials

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ABSTRACT

Objective: To evaluate cuspal deflection of large mesio-occluso-distal (MOD) cavities filled incrementally with a conventional composite resin in comparison with two bulk-fill flowable composite resins.

Materials and Methods: MOD standardized preparations were made in intact maxillary human premolars. Preparations had occlusal and proximal box isthmuses of one-half and two-thirds of the buccopalatal width, respectively. The occlusal depth was 3.5 mm from the tip of the palatal cusp and the gingival margins were located 1 mm above the cemento-enamel junction (CEJ). Preparations were treated with the etch-and-rinse adhesive All-Bond 2 (Bisco, Schaumburg, IL, USA) and restored according to each of the following groups. In one group, preparations were incrementally restored with Grandio SO (Voco) composite—three oblique increments for each box and two increments for the occlusal portion. Preparations in the other groups were restored to within 2 mm of the palatal cusp using a single increment of SureFil SDR Flow (Dentsply Caulk) or x-tra base (Voco). Grandio SO was used to complete these restorations and placed in two triangular-shaped increments. Receptors adapted to the buccal and palatal cusps were used to measure cuspal deflection. After measurement of cuspal deflection, restorations were finished and polished using Sof-Lex discs (3M ESPE) and finishing diamonds. Specimens were prepared for microleakage experiments and thermocycled prior to immersion in 0.2% basic fuchsin dye. After 24 hours, the teeth were sectioned and microleakage was evaluated under a stereomicroscope at 25× magnification.

Results: Statistical analysis showed a significant increase in the total cuspal deflection for the teeth incrementally restored with Grandio SO when compared with SureFil SDR Flow (SDR) and x-tra base. There was no difference between the bulk-fill flowable composite resins. There was no difference in cervical microleakage among the groups.

Conclusions: The bulk-fill flowable composite resins SDR and x-tra base significantly reduce cuspal deflection during light-activation when compared with a conventional composite resin placed incrementally. No deleterious effect on marginal adaptation was noticed when using these flowable composites.

COMMENTARY

This study supports the claims from manufacturers that bulk-fill flowable composite resins can replace dentin in one single increment. It would have been interesting to see the effect of bulk filling preparations that were 4 mm in depth in the occlusal step of the preparation as well. Although the gingival margin of the boxes exceeded 4 mm in depth, the occlusal step was fairly shallow. According to the authors, the depth in that aspect of the preparation was 3.5 mm from the tip of the palatal cusp. Taking that into consideration, the depth of the occlusal step of the preparation must have not exceeded 2.5 mm with two of those millimeters being filled with the

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conventional composite resin. Nevertheless, this study provides encouraging information concerning placement of such materials in bulk.

SUGGESTED READING

Burke FJ, Crisp RJ, James A, et al. Two-year clinical evaluation of a low-shrink resin composite material in UK general dental practices. Dent Mater 2011;27:622–30.

Tantbirojn D, Pfeifer CS, Braga RR, Versluis A. Do low-shrink composites reduce polymerization shrinkage effects? J Dent Res 2011;90:596–601.

Van Dijken JW. Durability of resin composite restorations in high C-factor cavities: a 12-year follow-up. J Dent 2010;38:469–74.

THE BOTTOM LINE

Considering the limited literature available on the topic, here are some considerations regarding the use of "bulk-fill" flowable composite resins:

- Just as any resin-based restorative, the properties of bulk-fill flowable composite resins are composition dependent. Research findings for a specific material should not be generalized to the entire product class.
- In vitro data suggest that these materials are safe for use as a dentin replacement, assuming that they are used as directed (e.g., with an appropriate curing time).
- Their use as the first increment in Class II preparations, and consequently as dentin and (proximal) enamel replacement, needs further investigation.
- No independent research is available on their use as a complete bulk-fill restorative (i.e., replacement of enamel as well as dentin) and therefore its use in such approach should be avoided. Except for very limited applications, this procedure is not currently recommended by manufacturers anyway.
- Restorative procedures can be greatly expedited by using bulk-fill flowable composite resins.

DISCLOSURE

The author is currently the PI for a clinical trial sponsored by Dentsply Caulk, manufacturer of SureFil SDR Flow. SDR is used as the restorative material after adhesive application in the clinical trial. The author has also recently participated in an "opinion leaders" forum which was sponsored by the same company. The author's expenses were paid by them. SDR was not discussed in that forum.

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