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# Comparing the Effect of Polymerization Shrinkage Between Bulk-Fill and Conventional Composite: A Systematic Review

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**Abstract**

**Introduction:**

A bulk-fill composite is a newly introduced resin-based material. It is considered as improvement in the resin-based restorations. Published literature about their physical and mechanical properties yield inconsistent or sometimes contradicting results. Therefore, in depth review of this literature could be a helpful guide for dentists to use these new promising restorative materials. This review aimed to provide an evidence-based comparison between bulk-fill and conventional composite.

**Methods:**

We searched electronic databases for articles, published in English language, that compare polymerization shrinkage between bulk-fill and conventional composite. Databases of PubMed and Embase were searched for clinical trials or cohort studies. The exclusion of the irrelevant studies based on the full text of articles was done to include finally 7 studies.

**Results:**

The polymerization shrinkage and stress of flowable bulk fill composite was assessed by 7 studies, and there was no large variation between findings of these studies. The mean percentage of polymerization shrinkage in flowable bulk fill composite was found to range from 2.8 to 4.40, while the mean percentage of polymerization shrinkage in paste-like bulk fill composite was found to range from 0.9 to 2.6. Like flowable counterpart, all studies found that polymerization stress of paste-like bulk fill composite to be lower than that of the conventional composite.

**Conclusion**:

Based on the available literature, there is no substantial difference in the polymerization shrinkage between bulk fill composite and conventional composite.

**Keywords**: Dental composite, Bulk-fill, Polymerization shrinkage, Microleakage

## Introduction

The most important characteristic of composite fillings is polymerization shrinkage, that affects the strength of the main filling and affects the bonding strength with tooth surface [1, 2]. The polymerization shrinkage is problematic, since it is considered as the main cause of poor marginal adaptation, microleakage, and occurrence of secondary caries.

Numerous clinical strategies, such as incremental technique with application of flowable lining material and modulation of light curing mechanism, have been used to decrease the incidence of these complications [2, 3]. The mostly used technique to overcome the drawback of polymerization shrinkage is the incremental layering of composite filling with no more than 2 mm per layer. This facilitates delivery of the light to the whole composite filling and subsequent curing of the resin material, as well as the reduction of polymerization shrinkage. [4, 5]. However, this incremental layering technique is time-consuming and dentists still need the easier and quicker method for composite manipulation.

A flowable bulk-fill composite is a recently introduced resin-based material. It is considered as advancement in the resin-based restorations with claims of light curability till 4 mm thickness. It could reduce the working time of the restorations to approximately half of that in the conventional composite [6]

Since those bulk-fill composites were recently introduced, the published literature about their physical and mechanical properties yield inconsistent or sometimes contradicting results. Therefore, in depth review of this literature could be a helpful guide for dentists to use these new promising restorative materials. This review aimed to explore the polymerization shrinkage associated with using of bulk-fill composite.

## Methods

An electronic search was conducted on PubMed, Wiley Online Library, and Science Direct search engines. The keywords used in search strategy were Bulk-fill dental composite AND polymerization shrinkage, in addition to Bulk-fill dental composite AND polymerization stress.

All articles published in English language were eligible to be included in this review. Only clinical trials or cohort prospective studies were included in this review. Simulation studies, animal studies, or studies conducted in-vitro were excluded. Articles included the search terms in any fields were screened (620 articles). After that, the duplicated and irrelevant studies were excluded based on their titles and abstracts (602 excluded articles). The full texts were retrieved for the other eligible articles to conduct in-depth screening for the tested properties of the bulk-fill composite (18 articles).

The exclusion of the irrelevant studies based on the full text of articles was done to yield finally included studies (10 articles). The extraction of required information in regards to polymerization shrinkage of bulk-fill composite was achieved adequately by tow reviewers read the included studies.

## Results and discussion

The polymerization shrinkage and stress of flowable bulk fill composite was assessed by 7 studies, and there was no large variation between findings of these studies. The mean percentage of polymerization shrinkage in flowable bulk fill composite was found to range from 2.76 to 4.4 in the findings of 4 included studies. Kim et al. and Benetti et al. found a higher mean percentage of polymerization shrinkage in flowable bulk fill composite than that in the conventional composite, while Zorzin et al. found polymerization shrinkage of flowable bulk fill composite comparable to that of conventional flowable composite but higher than that of conventional condensable composite.

The polymerization shrinkage of paste-like bulk fill composite was assessed by five studies, and there was no large variation between the findings of these studies [7-11]. The mean percentage of polymerization shrinkage in paste-like bulk fill composite was found to range from 90 to 2.63.

Mulder et al. and Benetti et al. found a higher mean percentage of polymerization shrinkage in paste-like bulk fill composite than that in the conventional composite, while Zorzin et al. found it lower to that of conventional flowable composite and comparable with that of conventional condensable composite (table 1).

The polymerization stress of flowable bulk fill composite was assessed by four studies [8, 10, 12, 13]. High level of polymerization stress was found by Kim et al. where mean stress (MPa) of flowable bulk fill composite ranged from 1.68 to 2.24. El-Damanhoury and Platt, and Zorzin et al. found that mean (SD) of polymerization stress ranged from 1.07 (0.1) to 1.65 (0.1). All these four studies found the polymerization stress of flowable bulk fill composite to be lower than that of conventional composite (table 2).

In regards to paste-like bulk fill composite, the polymerization stress was investigated by three studies [8, 10, 12]. A high level of polymerization stress was found by Kim et al. where mean stress (MPa) of paste-like bulk fill composite ranged from 2.36 to 2.42. El-Damanhoury and Platt, and Zorzin et al. found that mean (SD) of polymerization stress ranged from 1.07 (0.1) to 2.135 (0.07). As well as its flowable counterpart, all studies found the polymerization stress of paste-like bulk fill composite to be lower than that of conventional composite.

**Table (1): Summary of the findings regarding polymerization shrinkage of bulk-fill composite**

| Reference | Value range | Comparison to conventional composite |
| --- | --- | --- |
| **[7]** | Mean (SD) in %: [3.43% (60.51) - 4.40% (60.79)] | No comparison |
| **[14]** | Percentage of shrinkage= (2.99% - 3.05%) | Conventional composite had significantly lower shrinkage than flowable bulk fill composites. |
| **[15]** | Mean (SD) (micrometer) SDR 25.36 (1.49) VBF 32.14 (1.75) | Mean (SD) TF 35.75 (2.71) FS 11.13 (1.15) |
| **[10]** | Mean (SD) Filtek Bulk Fill= 3.34 (0.11) SDR Surefil=3.37 (0.55) Venus Bulk Fill=4.03 (0.24) X-tra Base=3.05 (0.3) | Bulk-fill flowable composite= 3.92 (0.48), while conventional condensable composite Z250=2.31 (0.57) |
| **[16]** | Mean (SD) in % = [2.76 (0.13) - 3.36 (0.13)] | Flowable bulk-fill resin composites demonstrated A higher polymerization shrinkage than conventional composite |

**Conclusions**

We found a low level of knowledge about vitamin D among PHC attenders with high level of concern about the current status of vitamin D. A low exposure for sunlight was reported with low use of sun protection. The knowledge of vitamin D deficiency had an effect on the respondents' attitudes and practices.

**Conflict of interests**:

The authors declared no conflict of interests

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**Table (2): Summary of the findings regarding polymerization stress of bulk-fill composite**

| Reference | Value range | Comparison to conventional composite |
|---|---|---|
| **[12]** | Measured in MPa =Mean (SD): [1.607 (0.04) - 1.649 (0.06)] | Flowable bulk-fill composite showed lower polymerization stress than conventional composite |
| **[13]** | The flowable bulk fill composite FBF (Filtek Bulk Fill composite generated a lower final stress than the Z250 sample under instrumental compliances less than ca. 4 m/N; | |
| **[15]** | Mean (SD) micrometer (Kgf)<br><br>SDR 3.08 (0.16)<br>VBF 4.34 (0.35)<br>GUF 5.59 (0.41) | Mean (SD) micrometer (Kgf) in TF= 4.02 (0.37), while in FS= 2.48 (0.15) |
| **[8]** | Mean stress MPa in SDR= 168<br>Mean stress in FB= 2.24 | The lowest shrinkage stress was exhibited in SDR, while Z350F showed the highest shrinkage stress ($p < 0.05$). There were no statistical differences among TNB, Z250, SF, and FB |
| **[10]** | Mean (standard deviation)<br>-Filtek Bulk Fill= 1.55 (0.11)<br>-SDR Surefil=1.33 (0.07)<br>- Tetric EvoCeram Bulk Fill= 1.07 (0.1)<br>-Venus Bulk Fill=1.65 (0.1)<br>-X-tra Base=1.45 (0.11) | The conventional flowable composite= 1.94 (0.2), while condensable composite Z250=2.31 1.23 (0.12) |


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