Original Article

COMPARATIVE STUDY OF COLOR STABILITY BETWEEN SDR FLOW MATERIAL AND PACKABLE COMPOSITE USING EASY-SHADE DEVICE

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ABSTRACT

Color stability has therefore been considered as one of the most important factors when selecting composite resin materials for aesthetic restorations. Over the past decade, SDR flow+ has become a popular aesthetic restoration for posterior teeth, and discoloration is one of its main features. Bulk-fill resin composites have gained popularity in recent years thanks to their improved depth of cure. This randomized control trial included 40 disks (20 SDR® flow+ Bulk Fill Flowable and 20 3M™ Filtek™ Z250 Universal, bulk fill composite restoration) that will be prepared in 8x8 mm plastic molds divided into 2 groups. The paired sample t-test shows a p-value less than .05, which means there is a statistically significant difference between the color stability of the two materials. However, SDR showed greater stability in tea, whereas bulk-fill in coffee. SDR is much more stable when exposed to tea, whereas bulk fill is stable under coffee. Both SDR and bulk fill composites are susceptible to shade change significantly.

Key words: Color stability, Packable composite, SDR flow material, Randomized control trial.

Introduction

It is the primary goal of esthetic dentistry to mimic the natural tooth structure as closely as possible in terms of color, shape, morphology, and translucent properties [1]. Bulk-fill resin composites have gained popularity in recent years thanks to their improved depth of cure [2, 3]. This is the result of incorporating larger filler particles, reducing the number of pigments, and changing the monomer systems of the composites [4, 5]. These bulk-fill resin composites can be applied and cured in thicker layers than conventional ones [6].

Smart dentin replacement (SDR) was the first clinically well-accepted bulk-fill material, and its volumetric polymerization shrinkage is lower than that of hybrid composites [7, 8]. Furthermore, the shrinkage stresses in SDR are lower than those in other bulk-fill composites [9]. Color stability is the ability of any dental material to be able to retain its original color [10, 11]. The oral cavity has a dynamic environment [12, 13]. With the continuous presence of microflora, saliva, and frequent intake of colored food (chromatogens), the color stability of an esthetic material may become compromised [14, 15]. However, the property of color stability of esthetic dental materials is often ignored over other physical and mechanical properties while making a choice [16].

Bulk-fill resin utilizes a special composition to produce a deep depth of cure. The qualities of the resin composite may be impacted by this particular chemical [17]. Even though bulk-fill formulations are mostly thought of for posterior applications, it is necessary to retain the resin's fundamental cosmetic properties. The durability of composite restorations as well as the dentist's choice to replace them may be impacted by color stability and surface microhardness. According to the United States Public Health System (USPHS), color match and anatomic shape, which includes abrasion resistance, are essential indicators of resin materials' service life and two of the criteria used to assess the quality of previous restorations. Extrinsic stains from a variety of sources, including smoking, certain meals, and beverages may damage composite restorations in the oral cavity. It's crucial to research how such staining processes affect composites made of bulk fill. This study's goal was to assess the color stability and surface microhardness of Bulk-Fill resin composite materials that were sold in Saudi Arabia after being exposed to popular drinks [18].

Both flowable and packable composites are accessible as restorative materials. Less filler in a flowable composite reduces viscosity and is easier to manipulate. Therefore, this matrix should ideally be more color-change-susceptible [19]. The pH of various consumable media of various drinks and the staining potential of various consumable media have been shown to impact the color stability of packable composites in the past by Omata *et al*. and Fontes *et al*. [20, 21]. Information on the color stability of flowable composite materials is few or restricted. Color perception is a psychological issue that is impacted by the observer's skill and may be characterized in a variety of ways. One of the most crucial characteristics of an aesthetic restorative

material, color stability is influenced by a variety of internal and external elements to determine the final result of the restorative material [19].

According to the location of the stain, tooth discolorations are divided into extrinsic and intrinsic staining. The focus here will be on the extrinsic discoloration type, caused by the accumulation of chromogenic substances on the tooth surface or in the pellicle layer. The etiology of these stains differs depending on the person's diet, habits, oral hygiene, and lifestyle [22]. Composite resin discoloration can occur in three ways: (I) extrinsic discoloration due to biofilm accumulation on the restoration surface; (II) surface or subsurface changes with slight penetration and the reaction of dye agents on the superficial layer of composite resin; (III) intrinsic discoloration due to physic-chemical reactions inside the body of the restoration [23].

Moreover, the matrix structure as well as the features of inorganic fillers have a direct effect on the surface smoothness of composite resin restorations and the staining ability. Hydrophilic matrices are more susceptible to water absorption, dye penetration, and staining than hydrophobic ones. 2 ISRN Dentistry Similarly, the filler type and size (glass, pyrogen silicon, and others) are also closely related to staining [24]. Among the countless things that can jeopardize dental esthetics, chromogenic beverages such as coffee and tea are among the most consumed drinks worldwide. Tannins present in both coffee and tea can cause a brown discoloration to the tooth to varying extents [25]. Ertaş *et al*. studied the staining potential of different drinks on composite resin and found that coffee caused greater staining than tea, which is by our study [26]. Color stability has therefore been considered as one of the most important factors when selecting composite resin materials for aesthetic restorations. Assessment of color stability and discoloration has also been included in commonly used outcome measurement tools that rate the success and failure of composite resin restorations in clinical practices [27]. Over the past decade, SDR flow+ has become a popular aesthetic restoration for posterior teeth, and discoloration is one of its main features.

Since color stability is a critical property to investigate, and because this material is used on anterior and posterior teeth, the current study's rationale is to determine the percentage of color change in comparison to traditional materials.

Aim of the study
This study aimed to compare the color stability between SDR flow+ material and conventional bulk-filled composite using an easy-shade device.

Hypotheses
There is no difference between SDR® flow+ Bulk Fill Flowable and 3M™ Filtek™ Z250 Universal Restorative, Syringe A2, and their color stability.

Materials and Methods

Study design
in vitro randomized control trial.

Sample size
40 disks (20 SDR® flow+ Bulk Fill Flowable and 20 3M™ Filtek™ Z250 Universal, bulk fill composite restoration) were prepared in 8x8 mm plastic molds divided into 2 groups.

The sample size was estimated using G Power software version 3.0.10. An effect size of 0.8 was the type I error was fixed at 5% and the power of the study was fixed at 80%. The sample size of 10 per subgroup was calculated.

Study reliability
We achieved intra-experiment reliability by using the same dimensions for all disks and the restorations were applied by the same hand.

In addition, all color measurements were done by the same device (Easy Shade).

Inclusion criteria
Sound intact composite disks with identical dimensions.

Exclusion criteria
Disks with defects, disks not within dimensions.

All disks were placed on an A4 paper and numbered from 1-20 for each group.

10 samples from each group were placed in Black Tea.

10 samples from each group were placed in Instant American Coffee.

- SDR® flow+ Bulk Fill Flowable shade Universal was used.
- 3M™ Filtek™ Z250 Universal, bulk fill composite restoration shade A2 was used.

Then the shade of all restorations was measured by an easy shade device and all obtained data was recorded in specially prepared tables, the disks were placed in the incubator inside sterilized water at room temperature for 24 hours for complete setting.

Then each group was divided into two subgroups, 10 disks were immersed in black coffee (Hintz Instant Café), 10 disks were immersed in breakfast tea (Alrabea Black Tea), and the immersion for all teeth lasted for 1 day (24 hours).

After removal, VITA Easyshade® V was utilized in assessing the changes in the shade for the two materials.

All data were subjected to statistical analyses using SPSS (SPSS, Chicago, IL) v 22.0 statistical software, where a paired sample t-test was done to compare the means of pre and post-experiment values.

There is no blinding consideration in our methodology.

Results and Discussion

Figure 1 shows the shade changes taking place in SDR disks by immersing in tea and coffee. It can be noted from the results that coffee produced a higher amount of shade change in SDR specimens as compared to the samples left in tea.

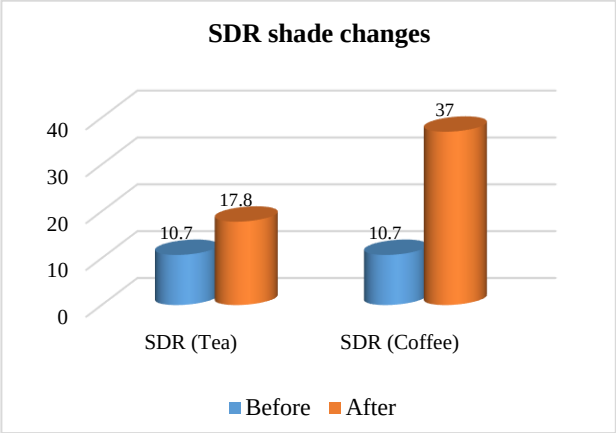

Figure 1. Comparison of shade change for SDR in tea and coffee.

Figure 2 shows the shade changes taking place in bulk-filled composite disks by immersing into tea and coffee. It can be noted from the results that tea produced a higher amount of shade change in bulk-filled specimens as compared to the samples immersed in coffee.

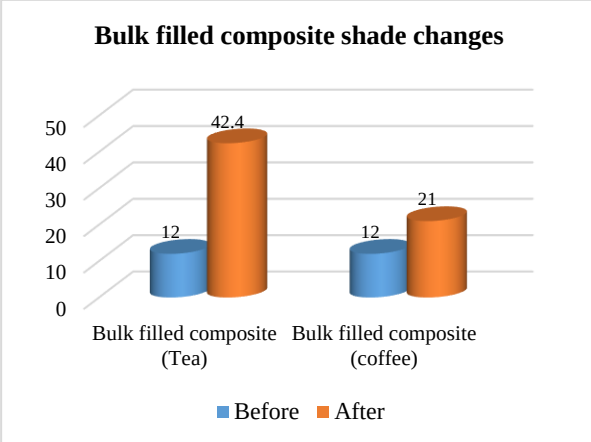

Figure 2. Comparison of shade change for bulk-filled composite in tea and coffee.

Table 1. Paired t-test findings

SDR (mean)		p-value	Bulk filled composite (mean)		p-value
Tea (before): 10.7	Tea (after): 17.8	.000	Tea (before): 12	Tea (after): 42.4	.003
Coffee (before): 10.7	Coffee (after): 37	.001	Coffee (before): 12	Coffee (after): 21	.000

Table 1 shows the comparison of both samples when immersed in tea and coffee with their p-values, which were calculated using paired t-tests in SPSS version 22. It can be noted from the findings that the shades of both materials immersed in tea and coffee showed a statistically significant change as all comparisons revealed a p-value less than 0.05.

Table 2. Comparison between two materials' color change when immersed in tea and coffee

Mediums	Tea (after being immersed)	Coffee (after being immersed)
Mean values	SDR: 17.8 Bulk fill: 42.4	SDR: 37 Bulk fill: 21
p-value	.010	.018

Table 2 shows the comparison between the two materials' color changes when immersed in tea and coffee. The paired sample t-test shows a p-value less than .05, which means there is a statistically significant difference between the color stability of the two materials. However, SDR showed greater stability in tea, whereas bulk fill in coffee.

Our results show that the shade changes while submerged in tea or coffee have undergone a statistically significant alteration. But coffee (p-value:.001) caused the greatest shift in shade in SDR. Tea, on the other hand, caused a greater shift in shade in the bulk-filled composite (p-value:.003). [28] reported comparable results. They found that specimens soaked in tea and coffee underwent a noticeable shift in shade. As opposed to traditional composite, Bulk-Fill composite resins showed decreased sensitivity to staining when exposed to tea, coffee, and berry juice, according to another research by Bahbishi *et al*. (2020) [29]. Regarding color alteration, there were no significant differences between the products examined by Bulk-Fill.

When immersed in different solutions, bulk-fill composites often have lower microhardness values [29]. Additionally, according to Paolone *et al*. (2023), bulk-fill materials exhibit inconsistent color constancy [30]. The variability of structure and staining methods in the chosen research papers may be blamed for this behavior. All the resins under investigation were shown to be susceptible to extrinsic staining with coffee, according to Arruda *et al*. (2021), with the Filtek Bulk Fill exhibiting the lowest shade change value [31]. This discovery is consistent with what we saw in the data.

When Bulk-Fill resins are used to restore proximal cavities with vestibular inclusion, for example, shade alterations might cause significant aesthetic damage in addition to serving as a secondary inquiry of the degree of polymer conversion. By elevating these resins to a level of restorative material with the easiest and quickest insertion procedure in posterior teeth, the bulk-fill restorative technique represents a crucial step forward in dentistry. Being a freshly developed material, it currently lacks long-term clinical investigations attesting to its clinical performance in a wide range of circumstances [16].

A different investigation by Shamszadeh *et al*. (2016) showed that bulk-fill composite resin exhibited better color vulnerability after immersion in coffee [32]. It is clear from the increment thickness that as the increment thickness increases, so does the color shift. They also revealed that thicker specimens may discolor more easily because bulk-fill materials have a shallower cure when inserted into them. These results support the expectations we had for our research.

According to Erdemir *et al*. (2017), bulk-fill composites varied in their shadow aversion to liquids [33]. The kind of pigment found in the staining solutions, the exposure period, and the composition of the resin composite material all affected how discolored the resin composites were after being exposed to them. It is possible to look at the ability of the new monomers utilized in the bulk-fill composites to absorb and adsorb colorants. Another investigation should concentrate on the color stability of bulk-fill composites after prolonged immersion.

Alandia-Roman *et al*. (2013) looked at 19 distinct bulk-fill composites and many artificial liquid staining techniques, such as coffee, red wine, tea, and coke. According to their findings [34], the tested bulk fill materials saw more color change than traditional resin-based composites.

SDR is a newly developed restorative material that, according to its proponents, has low viscosity and less polymerization shrinkage because it contains unique monomers. However, compared to traditional resin-based composite materials like Clearfil AP-X, flowable composites like Clearfil Majesty Flow display a lower viscosity but a larger shrinkage (manufacturer's undisclosed data) [30].

The findings showed that the tested composite resins' color changes varied significantly (p 0.0001) from one another. The bulk fills from Aura and Opus had the largest color change values.

The mean E00 values ranged from 0.5 for Saremco Microhybrid in saliva to 51.1 for Filtek Supreme in red wine, according to Ardu *et al.*'s (2018) analysis over a white backdrop [18]. After being submerged in staining solutions for 4 weeks, all materials displayed noticeable color changes. Significant variations between the investigated composite resins and staining treatments were also discovered. Reduced filler (37–53%) in a flowable composite means reduced viscosity. In one research by Yu *et al*. (2008), they compared the optical characteristics of a flowable composite to a packable composite made by the same manufacturer and found that they differed considerably from one another in terms of color, translucency, and fluorescence [35]. Less filler content and a larger percentage of the resin matrix, according to Santos *et al*. (2003), may retain different colors from intra-oral fluid [36].

Because flowable composites are more recent additions to the family of conventional composites and because less is known about them, Afzali *et al*. (2015) chose them [37]. According to Afzali *et al*.'s research from 2015, an acidic salivary pH of 6.5 causes a noticeable color shift regardless of the substance. Low pH may compromise the material's surface integrity and weaken the matrix, which would further encourage the absorption of different food colors and cause discoloration. The staining susceptibility of a restorative material may be attributed to its filler type or resin matrix. Staining solutions may cause composite resins to alter color. The CIE Lab system was used in research by Afzali *et al*., (2015) to evaluate color differences since it is suitable for identifying even minute color variations and has the advantages of sensitivity and reproducibility [37].

Conclusion

- There is a difference between SDR and bulk fill composites in their color stability when immersed in tea and coffee.
- SDR is much more stable when exposed to tea, whereas bulk fill is stable under coffee.
- Both SDR and bulk fill composites are susceptible to shade change significantly.
- Therefore, both materials can be used without any comparative judgment in patients requiring esthetic restorations.

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Ethics statement: This study received ethical approval from the REU ethical committee.

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