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Original Article

Analyzing the Clinical Effectiveness of Bulk-Fill Composites Using Standard Evaluation Criteria

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ABSTRACT

The present research aimed to evaluate three bulk-fill composites' clinical efficiency with that of a conventional micro-hybrid composite utilizing two different clinical assessment criteria. A total of 120 restorations were finished. The thirty randomly selected teeth were restored by a dentist using the four materials (GC Posterior-Group 1, Tetric Evo Ceram Bulk Fill-Group 2, Sonic Fill System-Group 3, and Filtek Bulk Fill-Group 4). For three, six, nine, and twelve months, patients were referred to the clinic. Applying USPHS clinical evaluation standards and FDI, Two physicians scored each restoration. SPSS version 22 was used to analyze intra-group and inter-group data for each criterion. After a year of examination, the surface polish, color stability, and surface structure of the Sonic Fill System and Filtek Bulk Fill composites were shown to alter considerably from baseline scores ($P < 0.05$). When the patients' views were tested for GC Posterior and Filtek Bulk Fill composites, the ratings revealed a notable change from the baseline values ($P < 0.05$). For all composite restorations, postoperative sensitivity diminished over time ($P < 0.05$). According to FDI and USPHS criteria, all of the restorative materials showed good clinical efficiency. It was discovered that the FDI criteria had a higher sensitivity of marginal discoloration than the USPHS criterion. The long-term clinical performance of bulk-fill composite materials requires a great deal more research.

Keywords: Bulk fill composite, Nanohybrid composite, Clinical evaluation criteria, Clinical evaluation

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Introduction

The goal of restorative procedures is to use the right materials to replace the missing dental structure. A restorative structure is the end outcome of treating dental caries [1, 2]. Both amalgam and composite materials are utilized in the foundation. The position of the tooth, the stresses acting on it, the patient's parafunctional behaviors, and their oral cleanliness all affect the material's indications. The range of applications for composite restorations has expanded due to recent advancements [3].

The usage of a specific thickness is required for the full polymerization of composite resins hardened with light, which is typically favored during cavity restoration. A maximum thickness of 2 mm has been established for this [4]. Recently, bulk-fill composites have entered clinical use; their content is comparable to that of traditional resin-based composites. These are materials that can be polymerized in a single step and

come in layers that are 4 or 5 mm thick. As a result, the danger of contamination is reduced during layer installation even though the treatment procedure is quicker and easier [5, 6].

In bulk-fill composites with higher thicknesses, polymerization using a light source in a single session presents challenges such as polymerization shrinkage stress and ensuring adequate polymerization. While manufacturers differ, comparable problems in these composites have been addressed by increasing the size of the monomer, changing the organic matrix, and adding inorganic fillers. The inorganic filler content has been supplemented with ytterbium trifluoride, barium glass, and zirconium particles, while the organic portion has been supplemented with high-branching methacrylate, aromatic UDMA, and hydroxyl-free BisGMA [5]. However, the base's organic structures contain composite elements including BisGMA, UDMA, TEGDMA, and EBPDMA monomers.

Bulk-fill composites, such as Smart Dentin Replacement (SDR) technology, comprise proprietary urethane dimethacrylate with photoactive groups that are intended to regulate the kinetics of polymerization. There have been reports of using Tetric Evo Ceram as a supplementary camphorquinone/amine starter in conjunction with an Ivocerin starter to speed up and deepen polymerization. Regarding starter systems, there has been no recorded variation in other bulk-fill materials. All producers employ the straightforward technique of reducing the amount of filler while increasing the translucency to increase the depth of polymerization [7]. Bulk-fill composites are divided into two categories based on their viscosity: low and high. A posterior composite must be used to complete the restoration at the topmost layer since low-viscosity materials have poorer mechanical qualities. High-viscosity materials can be polymerized without requiring an additional composite for the final layer [5, 8].

By adjusting the variables outside of the settings under study, in-vitro research can evaluate the mechanical and physical characteristics of recently discovered restorative materials. For example, a decrease in microhardness may cause the material to break down or deteriorate. Without using the substance in the mouth, in-vitro tests can provide insight into a number of its characteristics. However, since the primary function of restorations is to be used in the mouth, a variety of variables, including bacteria, chemicals, and oral fluids—most notably saliva—can have an impact. Materials must therefore be processed in a series of in-vivo tests following adequate in-vitro studies [9].

For a clinical study to be meaningful and able to standardize follow-up, internationally accepted norms must be used. The developed International Modified Ryge Criteria (USPHS-Modified United States Public Health Service), FDI (World Dental Federation), and CDA (California Dental Association) criteria are commonly utilized for assessing restorations.

The degree to which restorations meet the USPHS criteria is the basis for evaluating their clinical acceptability. Evaluation criteria that are clinically significant for dental restorations have been developed, including color compatibility, edge discoloration, retention, anatomic form, edge compatibility, surface structure, secondary decay, and postoperative sensitivity. As per the new USPHS standards, the restoration's defined qualities are assessed using Alpha, Bravo, and Charlie scores based on the patient's appraisal, radiographs, and visual inspection using assistive manual instruments. According to these scores, Charlie represents the lowest score and Alpha the highest [10, 11].

The FDI standards, which were established for the direct and indirect assessment of restorations, were released in 2007. Three primary categories—aesthetic, functional, and biological criteria—, as well as subgroups within each category, are used to evaluate restorations. The subcategory scores and the group's lowest scores are used to calculate the final points for the three main categories. During the evaluation, a score ranging from 1 to 5 is assigned. When these criteria are evaluated, a restoration with a score of 1, 2, and 3 is considered clinically sufficient; a restoration with a score of 4 is considered clinically insufficient but repairable, and a score of 5 indicates that the restoration is clinically deficient. As a result, conclusions are drawn regarding the restoration's acceptability and, if it is deemed unsuitable, its repairability. Partially successful ones are those that can be fixed, and fully unsuccessful ones are those that cannot [12].

The objective of the present research was to evaluate and contrast the clinical characteristics of different bulk-fill composites with those of traditional composites utilized to restore interface caries.

Materials and Methods

Patient selection

This study was planned as an in-vivo examination within the limitations of the specified criteria. The Dicle University Dentistry Faculty's Local Ethics Committee approved the study before its implementation (decision no: 2017/8). The Restorative Dental Treatment Clinic at Dicle University served as

the study's site. Informed consent was provided by each patient participating in the trial.

From a total of 120 posterior teeth with interface caries, 30 were selected at random to form the control group and the remaining 90 teeth with interface caries formed the study group.

Both groups underwent clinical and radiographic examinations before treatment. The clinically recognized universal composite (Gradia Direct Posterior/Gradia -DP) was used with group 1 (control group). Group 2 used Tetric Evo Ceram Bulk-Fill/Ivoclar Vivadent, a bulk-fill composite that had an Ivocerin starter added to camphorquinone. Group 3 used a sonic technique to apply a bulk-fill material (SonicFill 2Bulk-Fill/Kerr) to the cavity. Group 4 used Filtek Bulk-Fill/3M ESPE, a bulk-fill composite material with a camphorquinone initiator. Random selection was used to choose the restorative substance to be used on the teeth.

Inclusion criteria

Patients with at least one interface caries, good oral hygiene, an openness to learning about dental caries and the advantages of restoration, a willingness to attend follow-up exams at specific intervals, clinical and radiographic confirmation that the decay could be restored, and contact between the teeth and opposite teeth were all eligible to participate in the study.

Clinical protocol

The vitality of the teeth to which the restoration was to be applied was evaluated using a digital vitalometer (Digitest II, Parkell Inc, USA). Local anesthetic was applied before the procedure or as required during the procedure, taking into consideration the depth of the decay and the pain threshold of the patient. In the tooth with the decay, a cavity was opened with a diamond drill and fissure burr with the tooth surface underwater cooling with an aerator. The cavity was cleaned with a steel drill with a slowly rotating micromotor. Until there was no more degradation, this process was repeated. After that, sterile cotton pellets were used to dry the cavity after it had been cleaned with water. Saliva absorbers and cotton rolls were utilized for isolation. After the treatment was completed, the depth of the opened cavity was measured. If the opening was deep, calcium hydroxide was applied to the deepest location to repair the dentin and create a superficial layer of necrosis. The material was applied to the cavity layer above. After applying the bonding agent, the required composite material was applied to the cavity following the manufacturer's instructions. A sectioned matrix band (Palodent V3/Dentsplay, USA) was applied to the cavity with a wedge of the proper width.

Group 1; After preparation of the teeth, the defined self-etch adhesive system (Clearfil S^3 Bond- Kuraray, Sakazu, Kurashiki, Okayama, Japan) was applied to the cavity wall following the manufacturer's instructions in the guide to the material, using a brush for 10 secs then after waiting 20 secs isolated from blood and saliva, it was dried for a further 5 secs with air spray and another thin layer of the bond was applied. Polymerization was applied with an LED light source at 400-550 nm wavelength for 10 secs. Using the incremental layering technique, Gradia Direct Posterior composite (GC Corp, Tokyo, Japan) was applied to the cavity in 2 mm layers and each layer was polymerized with light for 20 secs.

Group 2; After opening the cavity and completing the adhesive process in the same manner as for group 1, Filtek bulk-fill (Filtek Bulk-Fill/3M ESPE) single-use capsule material was placed in an application gun and was applied to the cavity in a single layer of 4-5mm. During placement, the tip of the single-use capsule was placed close to the deepest point, and care was taken when withdrawing. Thus it was aimed to avoid unwanted gaps in the composite.

Group 3; Tetric Evo Ceram Bulk-Fill composite (Ivoclar Vivadent Schaan, Liechtenstein) was applied to the prepared cavity in 4mm layers and was condensed and shaped with appropriate manual instruments. Then polymerization was applied with an LED light source at 400-550 nm wavelength for 20 secs to the occlusal, buccal, and lingual surfaces.

Group 4; Sonic 2 Bulk-Fill was applied with an appropriately shaped handpiece adapted for the unit. The tips of the single-use composite were placed on the handpiece as defined in the instructions. Placement of the material, which has a level of application from 1 to 5 was achieved in all the cavities at level 3 at the standard rate at a thickness of 4-5 mm. Then, polymerization was applied with an LED light source at 400-550 nm wavelength for 20 secs to the occlusal, buccal, and lingual surfaces.

When polymerization was completed, the finishing and polishing procedures of the restorations were applied first with surface smoothing using fine-grained diamond burrs with yellow bands together with water cooling. Occlusion compatibility of the restorations was obtained and composite sandpaper was used on the interfaces. Then the polishing procedures were completed using Arkansas stone, yellow composite varnish rubbers, and polymax-impregnated varnish felt (TDV dental), respectively. The edges of the restoration were checked very often with a fine-tipped probe. Following the procedures, oral hygiene education was given to patients by explaining dental

care related to oral hygiene health and it was aimed to raise awareness in the patients.

Clinical evaluation

Patients were requested to attend the clinic for evaluations at 3, 6, 9, and 12 months after the application of the restoration. Evaluations of the restorations were made according to the FDI criteria together with the modified USPHS criteria. The teeth with the restorations were dried with pressurized air spray and isolated with cotton rolls, then examined with a mirror and probe. When necessary, radiographs were taken and the vitalometer device was used.

The scoring of the FDI criteria was as follows: 1 = the restoration is excellent or there is no clinical deficiency, 2 = excellent if sufficient characteristics can be obtained after a small change, 3 = can be used clinically but there are 1 or more insufficient characteristics, 4 = the restoration does not have sufficient characteristics but can be used clinically with repair, 5 = completely insufficient clinical characteristics and there is an indication for change.

If there was a loss of retention in the restoration, it was only evaluated in respect of this criteria without examination of the other criteria, and it was not included in subsequent evaluations. For restorations scored as 4 points, evaluations were terminated after repairing. In localized defects, conditions that can be repaired include the addition of filling material to small openings and fractures, changing a part of the restoration, or when discolored areas are limited.

Statistical analysis

Data obtained in the study were analyzed statistically using IBM SPSS Statistics version 22 software. In the evaluation of the FDI criteria, the Shapiro-Wilk test, Friedman's Two-Way ANOVA, and the Kruskal Wallis H-test were used. Pearson Chi-square analysis and the Wilcoxon test were used in the evaluation of the USPHS criteria. A value of $P < 0.05$ was considered statistically significant.

Results and Discussion

Every patient showed up for their follow-up appointments, although one patient in group 3 complained of excruciating nighttime discomfort in the fifth month and was sent to the endodontics clinic with the recommendation that they needed a canal. As a result, group 3's evaluation was finished with 29 restorations, for a total of 119.

FDI criteria findings

Applying the FDI criteria, the findings of the restoration evaluations were statistically analyzed and compared within and between groups.

Table 1 displays the statistically significant findings from the intra-group assessments and the inter-group comparisons in **Table 2**.

Table 1. The statistically significant results of the intra-group

Groups	**1. Group**					
Criteria/ Scores	P-values between months					
	3-6	3-9	3-12	6-9	6-12	9-12
Surface lustre	P = 0.392, P > 0.05					
Staining	P = 0.194, P > 0.05					
Patient's view	0.18	**0.043**	**0.043**	0.083	0.083	1.00
Post-operative sensitivity	**0.005**	**0.006**	**0.006**	**0.046**	**0.046**	1.00
	2. Group					
Surface lustre	P = 0.392, P > 0.05					
Staining	P = 0.121, P > 0.05					
Patient's view	P = 0.392, P > 0.05					
Post-operative sensitivity	**0.004**	**0.010**	**0.018**	0.317	0.705	0.317
	3. Group					
Surface Lustre	1.00	0.157	**0.014**	0.157	**0.014**	**0.046**
Staining	1.00	0.083	**0.025**	0.083	**0.025**	0.157
Patient's view	P = 0.733, P > 0.05					
Post-operative sensitivity	P = 0.091, P > 0.05					

			4. Group			
Surface lustre	1.00	0.317	**0.014**	0.317	**0.014**	**0.025**
Staining	1.00	0.157	**0.025**	0.157	**0.025**	0.083
Patient's view	**0.046**	**0.046**	**0.046**	1.00	1.00	1.00
Post-operative sensitivity	**0.001**	**0.001**	**0.001**	0.317	0.317	1.00

- Values with P < 0.05 as a result of statistical examination are highlighted with dark bold.
- The findings of analyzing the restorations following FDI standards are shown in this table.

Table 2. The statistically significant results of the inter-group comparisons.

P values Criteria	**Surface luster**				**Surface staining**			
	3 months (mths)	**6 mths**	**9 mths**	**12 mths**	**3 mths**	**6 mths**	**9 mths**	**12 mths**
1-2 Groups	0.272	0.272			1	1		
1-3 Groups	**0.015**	**0.015**			1	1		
1-4 Groups	**0.014**	**0.014**	P > 0.05 P = 0.052	P > 0.05 P = 0.649	0.471	0.471	P > 0.05 P = 0.221	P > 0.05 P = 0.244
2-3 Groups	1	1			0.154	0.154		
2-4 Groups	1	1			1	1		
3-4 Groups	1	1			**0.041**	**0.041**		
	Margin staining				Colour match and translucency			
	3	6	9	12	3	6	9	12
1-2 Groups	0.06		0.397		1	1	1	
1-3 Groups	**0.012**		**0.027**		0.255	0.255	0.436	
1-4 Groups	**0.011**	P > 0.05 P = 0.111	0.101	P > 0.05 P = 0.052	1	1	1	P > 0.05 P = 0.141
2-3 Groups	0.511		1		0.072	0.072	**0.049**	
2-4 Groups	0.508		1		1	1	1	
3-4 Groups	1		1		**0.017**	**0.017**	**0.049**	
	Patient's view							
	3	6	9	12				
1-2 Groups	**0.025**	**0.024**						
1-3 Groups	0.082	**0.028**						
1-4 Groups	0.176	**0.001**	P > 0.05 P = 0.067	P > 0.05 P = 0.070				
2-3 Groups	1	1						
2-4 Groups	1	1						
3-4 Groups	1	1						

- Values with p <0.05 as a result of statistical examination are highlighted with dark bold.
- The findings of analyzing the restorations following FDI standards are shown in this table.

Modified USPHS criteria findings

Intra-group evaluations

The analyses' statistically significant findings are displayed in **Table 3**.

Table 3. The statistically significant results for intra-group evaluations with the USPHS criteria.

The statistically significant results for intra-group evaluations with the USPHS criteria			
Criteria	**Groups**	**3. Month**	**P-values**
Color match	4. Group	12. month	0.014
Surface texture	3. Group	12. month	0.025
	4. Group	12. month	0.014

Postoperative sensitivity	1. Group	6. month	0.046
		9. month	0.014
		12. month	0.014
	2. Group	9. month	0.046
	3. Group	9. month	0.046
		12. month	0.046
	4. Group	6. month	0.008
		9. month	0.005
		12. month	0.005

- This table displays only statistically significant data (P < 0.05).

A statistically significant difference between color compatibility at three and twelve months was found in the Filtek bulk-fill group. 80% of those with Alpha color compatibility at three months were Alpha, and 20% were Bravo (P = 0.014) after twelve months.

In the Sonic-Fill system, a statistically significant distinction was identified between the surface structure at 3 and 12 months (P = 0.025). Of those with Alpha surface structure at 3 months, and 12 months, 82.76% of these were Alpha and 17.24 % Bravo.

The surface structure at 3 and 12 months showed a statistically significant difference in the Filtek bulk-fill group (P = 0.014). At 12 months, 80% of those with Alpha surface structure at 3 months were Alpha, and 20% were Bravo.

The postoperative sensitivity at 3 and 6 months was shown to differ statistically significantly in the GC group (P = 0.046). At six months, all patients who had Alpha postoperative sensitivity at three months were Alpha. At three months, postoperative sensitivity was found to be 40% Alpha and 60% Bravo.

Of those with Alpha postoperative sensitivity at 3 months, 100% were Alpha at 9 months and 12 months, while 60% of those with Bravo postoperative sensitivity at 3 months were Alpha and 40% were Bravo. In the GC group, the distinction between the postoperative sensitivity at 9 and 12 months was statistically significant (P = 0.014).

The postoperative sensitivity at 3 and 9 months was found to differ statistically significantly in the Tetric Evo Ceram Bulk-Fill group (P = 0.046). At nine months, all patients who had Alpha postoperative sensitivity at three months were Alpha. At three months, 33.33% of patients with Bravo postoperative sensitivity were Alpha, and 66.67% were Alpha.

The postoperative sensitivity at 3 months, 9 months, and 12 months indicated a statistically significant distinction in the Sonic-Fill system group (P = 0.046). Alpha postoperative sensitivity at three months was present in 33.33% of patients with Bravo postoperative sensitivity at three months, and Alpha was present in 66.7% of patients at nine and twelve months.

The postoperative sensitivity at 3 and 6 months was shown to differ statistically significantly in the Filtek bulk-fill group (P = 0.008). At six months, all patients who had Alpha postoperative sensitivity at three months were Alpha. At three months, 77.78% of patients with Bravo postoperative sensitivity were Alpha, and 22.22% were Bravo.

There was a statistically significant difference in the Filtek bulk-fill group's postoperative sensitivity at three, nine, and twelve months (P = 0.005). All patients with Alpha postoperative sensitivity at three months were Alpha after nine and twelve months. Three months after surgery, 11.11% of patients with Bravo postoperative sensitivity were Bravo, and 88.89% were Alpha.

Inter-group evaluations

Tables 4 and 5 display the statistical analysis' noteworthy findings.

Table 4. P values are determined based on the assessment outcomes between groups at 3, 6, 9, and 12 months, following Usph's criteria.

USPHS Criteria	P-values			
	3. Month	6. Month	9. Month	12. Month
Color match	**0.027**	0.125	0.48	0.74
Marginal discoloration	0.168	0.508	0.192	0.138
Retention	-	-	1.00	1.00

Anatomical form	0.334	0.761	0.761	0.515
Marginal adaptation	0.246	0.189	0.189	0.395
Surface roughness	**0.017***	0.074	0.519	0.697
Secondary caries	-	-	-	1.00
Postoperative sensitivity	0.558	0.484	0.58	0.611

- Dark bold is used to indicate values that, after statistical evaluation, have P < 0.05.
- The findings of analyzing the restorations following FDI standards are shown in this table.

Table 5. Alpha percentage values of groups at times show significant P-values.

USPHS criteria	Alpha value percentages of groups				Significant P-values
	1. Group	2. Group	3. Group	4. Group	
Color match-3. month	**%93.33**	%93.33	%79.31	%100	**0.027**
Surface roughness-3. month	**%83.33**	%93.33	%100	%100	**0.017**

- Dark bold is used to indicate values that, after statistical evaluation, have P < 0.05.
- The findings of analyzing the restorations following FDI standards are shown in this table.

When restoring posterior cavities, technique-sensitive restorations and procedure time are concerns, the bulk fill materials may be helpful [13].

The most widely used approach in clinical investigations is the USPHS criteria, which help assess the clinical success of restorations. In contrast to other criteria, they are less sensitive to revealing disparities. It is important to consider the effects of all dental variables when drawing this conclusion [14]. The findings of a 12-month randomized clinical trial measuring adhesion effectiveness were evaluated by de Paula *et al*. [15], who concluded that the USPHS parameters were less vulnerable to modest fluctuations in clinical outcomes than the FDI assessments. The percentage of outcomes that met the USPHS requirements was significantly higher, as reported by Durão *et al*. [16]. In their 36-month follow-up research, Loguercio *et al*. examined restorations made with self-etch and total-etch systems and discovered that the FDI standards were more sensitive than USPHS parameters in terms of marginal compatibility and marginal discoloration [17]. The FDI criteria were shown to yield more sensitive results in the marginal discoloration findings of the current investigation.

After two years, Akalın *et al*. [18] found that restorations using a high-viscosity, nano-hybrid, bulk-fill composite applied to Grade II cavities with sonic activation had satisfactory success. Nonetheless, a decline in color compatibility and translucency was observed during the first six months when compared to the original restoration [18]. During 24 months, Sirin Karaarslan *et al*. [19] evaluated the clinical efficacy of two bulk-fill composite resins in class II cavities and discovered statistically significant differences in the color match criterion among the three restorative resins. According to the clinical assessment of bulk fill composites by Balkaya *et al*. [20], there was no statistically significant distinction in color match between the bulk fill composite and conventional composite. Similar discoloration results were seen at 12 months in the current investigation when compared to the values at 3 and 6 months for restorations made using the Sonic Fill System and Filtek Bulk-Fill composite.

In research by Barutcigil *et al*. [21], the color change was assessed in vitro in three bulk-fill composites and nano-hybrid resin composites. It was found that, unlike bulk-fill composites, which showed an increase in color change over time, the color change in nano-hybrid composites stabilized after one week [21]. At the six-year evaluation, Yazici *et al*. discovered that the conventional composite's marginal discoloration had increased over time [22]. It is widely known that coloration may lighten when fillers do not undergo polymerization because the composition of nanofilm composites has greater total surface areas per unit of fillers [23]. Thus, the discoloration over time of Filtek Bulk-Fill composite, which has a nanofil structure, with sonic fill composite, which is in a nano-hybrid structure, is an outcome that can be predicted when compared to GC posterior composite, which is a micro-hybrid composite.

3.3% of restorations made with Filtek Bulk Fill composite may not be adequate after a year, according to a clinical study by Canali *et al*. [24] that evaluated the restorations of 89 cervical lesions free of caries.

Additionally, Hardan *et al*. [25] evaluated the research's posterior cavities using the Composite-Up Layering Technique (CULT) and the Fast-Modelling Bulk Technique (FMBT). Based on the present research, discoloration happened more frequently with CULT than with FMBT. There was degradation in the anatomic form of Class II restorations, but no obvious variation was detected in Class I restorations at the end of 10 years of research by Heck *et al*. [26] that compared restorations performed with Tetric Ceram and Quixfill Bulk-Fill composite. Based on Van Dijken *et al*. [27], there was no significant distinction in the evaluation of anatomic form between Ceram X mono used through the layering method and Ceram X mono used as the final layer with SDR implanted with the bulk-fill approach during the 5-year clinical follow-up. Akalın *et al*. [18] and Atabek *et al*. [28] said that clinical studies with Sonic Bulk-Fill composites also showed no noticeable change. The Tetric Evo Ceram Bulk Fill restoration group and the other resins at baseline in the anatomic form category showed significant distinctions, based on a one-year investigation by Durão *et al*. [16]. There were no noteworthy findings for any of the two parameters in the one-year evaluation in the present research. Although evaluations of long-term studies have found varying results, shorter-term studies have shown no discernible changes when the period of prior research is taken into account.

Bulk-fill composites are believed to increase patient satisfaction during the process since they reduce the length of therapy. Additionally, composites with nanofil filler have a smoother surface, which is known to be able to be preserved for a longer time, when surface qualities are taken into account about the filler amount of the composites utilized [29]. The bulk fill composite was reconstituted using either the bulk fill technique or the incremental technique after a year, according to Suneelkumar *et al*. [30]. According to this investigation, there was no discernible variation in the patients' perspectives [30]. It is well recognized that surface characteristics during function influence the patient's perception.

Postoperative sensitivity is a subjective finding that can be influenced by a variety of variables, such as the patient's pain threshold, the distance of the cavity from the pulp, the kind of surgery chosen, whether or not the restoration and adhesives were used properly, and the effectiveness of isolation. In 12-month research, Bayraktar *et al*. [31] assessed four composites using USPHS standards, and Bravo scores were used for three restorations at one week and three months for Clearfil Photo Posterior composite, one restoration at one week, six months, nine months, and twelve months, two restorations at one and three months for Filtek bulk-fill flow and Filtek P60 composite, and one restoration at one week and three months for Tetric Evo Ceram Bulk-Fill and Sonic Fill composite. In the other months, no postoperative sensitivity results were identified [31].

Hickey *et al*. [32] conducted a clinical study to assess the postoperative sensitivity outcomes of hybrid and bulk-fill composite restorations. They discovered that bulk-fill composites in class I cavities enhanced chewing sensitivity. Based on a study by Tardem *et al*. [33], only 7.40% of patients suffered postoperative sensitivity, and this discomfort did not appear for over forty-eight hours. However, with time, the sensitivity lessened and was determined to be temporary. They showed that the adhesive strategy (etch-and-rinse vs. self-etch), presentation mode (syringe vs. capsule), and restorative approach (incremental vs. bulk) did not affect the risk of postoperative sensitivity [33]. Postoperative sensitivity was shown to decline with time in the present research.

No indications of postoperative sensitivity were found in any restorations during a 12-month clinical follow-up comparing Tetric Evo Ceram and Tetric Evo Ceram Bulk-Fill composites [34]. According to a research deep cavities showed higher postoperative sensitivity than superficial and intermediate-depth cavities. The main reason for sensitivity in all groups of the present study was the creation of deep holes of at least 4-5 mm to be included in the research. In the area around the pulp, the pain mechanism is brought on by an increase in dentin canals and odontoblast extensions. These dentin canals contain mechanoreceptor nerves, and fluid movement brought on by interventions such as cuts performed during the preparation and restoration process, heat generated, drying, and pressure changes cause discomfort [35].

Though two restorations received clinically acceptable levels in research by Canali *et al*. [24] that examined restorations of cervical lesions devoid of cavities, the Filtek Supreme Ultra Universal composite exhibited higher surface smoothness than the Filtek Bulk-Fill composite. Heck *et al*. [26] examined teeth treated with hybrid composite and bulk-fill composite in a ten-year research. They discovered that the Quixfill composite did not significantly alter the surface structure of Class I cavities, but it did significantly alter Class II cavities [26]. Surface roughness was the sole statistically significant difference between the bulk fill materials investigated in a one-year study by Ehlers *et al*. [36].

Conclusion

The study's findings demonstrated that, following the FDI and USPHS criteria, the clinical success of every substance was adequate. It was discovered that the FDI criteria were more sensitive to marginal discoloration than the USPHS standards. It was determined that the composites utilized in the study had adequate therapeutic qualities and could be applied to standard therapies after the one-year trial period. However, more long-term clinical research on bulk-fill composites is required.

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Conflict of Interest: None

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