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Original Research Article

Comparison of Postoperative Sensitivity between Bulk-Fill Composite Restoration and Conventional Composite Restoration, Randomized Controlled Trial

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Abstract: *Postoperative sensitivity is a common concern following composite resin restorations, particularly in posterior teeth. Differences in restorative techniques, such as the use of conventional versus bulk-fill composites, may influence patient-reported sensitivity. However, evidence comparing these two approaches remains limited.* ***Objective****: To compare the frequency of postoperative sensitivity to thermal stimuli (hot and cold) in Class I posterior cavities restored with conventional composite resin versus bulk-fill resin composite.* ***Methods****: This randomized controlled trial was conducted at the Department of Operative Dentistry, Islamic International Dental College/Hospital, Islamabad, from September 30, 2024, to March 29, 2025. A total of 270 teeth were included and randomly allocated into two equal groups: Group A (n=135) received conventional composite restorations, and Group B (n=135) received bulk-fill resin composite restorations. Participants aged 20–60 years of either gender were enrolled using a non-probability purposive sampling technique. Postoperative sensitivity to thermal stimuli (hot and cold) was assessed, and data were analyzed using appropriate statistical tests with a significance level set at p < 0.05.* ***Results****: Group A had a mean age of 39.53 ± 11.60 years, and Group B had a mean age of 42.47 ± 11.63 years. In Group A, 6 patients (4.4%) reported postoperative sensitivity to hot stimuli, compared to 9 patients (6.7%) in Group B (p = 0.425). Sensitivity to cold stimuli was observed in 3 patients (2.2%) in Group A and 9 patients (6.7%) in Group B (p = 0.076). The differences between the two groups were not statistically significant.* ***Conclusion****: There was no statistically significant difference in postoperative sensitivity to thermal stimulation between Class I posterior restorations completed with bulk-fill composite resin and those restored using conventional composite resin. Both materials appear comparable in terms of short-term thermal sensitivity outcomes.*

Keywords: Postoperative Sensitivity, Bulk-Fill Composite Restoration, Conventional Composite Restoration

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Introduction

In modern dentistry, extensive advances in adhesive technologies, paralleled by increased focus on the esthetic appearance of restorations and extensive use of minimally invasive methods, have radically influenced clinical choice-making for both anterior and posterior teeth. The advances have turned the emphasis to conserving as much of the natural tooth structure as possible and obtaining highly esthetic and long-lasting restorative results. The confluence of these technologies enables clinicians to provide restorations that not only restore function but also address patients' growing demands for esthetically appealing results, ultimately determining a more conservative and patient-centered paradigm in restorative dentistry (1,2).

Making an optimal restorative dental treatment which fulfills functional and aesthetic demands is one of the key missions of dental workers. Even after obtaining technical success, dissatisfaction usually arises because patients may experience postoperative pain or discomfort. The persisting pain could negatively impact the perceived procedure success. Several potential causes are likely to exist behind such pain, including inflammation of gingiva, underlying periodontal disease, and foremostly, dentin hypersensitivity due to surgery. Of these, dentin hypersensitivity is most often recognized as the major reason for patient discontent after routine restorative care since it can persist and have a detrimental impact on quality of life despite an otherwise successful clinical outcome (3, 4).

Restoration of the carious or broken-down teeth can be restored using different materials such as amalgam and composites etc. Composite restoration has been used as an alternative to amalgam for restoring posterior teeth (5). Composite is a tooth color restorative material use for anterior as well posterior permanent restorations.

The reason is composite is aesthetic restoration, better strength as compare to other available restorative materials and there are no mercury related health issues associated with composite restoration. Composite restoration is most commonly used but it also has certain disadvantages such as technique sensitive which require good isolation for proper bonding to tooth substrate failure to achieve those results in marginal discoloration, micro-leakage and postoperative sensitivity. The main disadvantage is volumetric polymerization shrinkage on curing. To reduce the polymerization shrinkage stress, incremental layering of the resin composites has been recommended for de-cades (6).

Polymerization shrinkage stress is the main drawback of composite resin restorations, because it may lead to poor marginal adaptation, then microleakage and subsequent secondary caries which may lead to pulp inflammation (7). Clinical researches have reported that the postoperative sensitivity result led to increase cuspal deflection and increase stressesat the interface when placing 4 or 5 mm-thick increments of resin are different techniques ofcomposite restoration like bulk-fill. In a study done in Jamshoro/Hyderabad, no pain wasreported in 105 (95.5%) and 110 (100%) patients, while mild pain was reported in 5 (4.5%) patients in group A and none in group B (8). Conventional and Bulk-fill resin composites are the materials of choice in direct dental restorations because they result in lower postoperative shrinkage and higher reactivity to light polymerization than most conventional composites due to increased translucency, improving the light penetration and the depth of cure. The use of bulk-fill composite, presented in capsules or syringes, is less time consuming and does not increase the risk or intensity of postoperative sensitivity relative to the traditional incremental techniques.[9] The introduction of bulk-fill composite resins on the market, many studies have been done comparing the different properties between conventional resins and bulk-fill resins, showing conflicting results. Currently, bulk-fill resin composites are the materials of choice in direct dental restorations (10).

Methodology

This randomized controlled trial (RCT) was conducted in the Department of Operative Dentistry, Islamic International Dental College/Hospital Islamabad from 30th September 2024 to 29th March 2025. Ethical approval was obtained from hospital ethical committee. 270 teeth (135 per group) were calculated using the WHO calculator, with 5% level of significance and 80% study power adopting anticipated percentage of postoperative sensitivity with cold change posterior restoration i.e. 4.5% with bulk-fill restoration and 0% with conventional composite restorations in class I cavities (8).

Each patient was briefly explained to by the dentist as to the nature of intervention to be done on their teeth. Informed written consent was secured for utilization of their data for research purposes. Confidentiality of all personal data was utmost. Demographic information such as age, gender, size of cavity as seen under radiographic examination, and number of the tooth was noted.

The teeth were assigned at random into two groups by the lottery method: Group A was restored with conventional composite resin restorations, and Group B was restored with bulk-fill resin composite restorations. Both male and female volunteers, aged 20-60 years, were recruited within the study by a non-probability purposive sampling method. Individuals were excluded from the study if they presented with mixed dentition, underwent root canal treatment, had teeth with insufficient crown height, or exhibited inadequate oral hygiene.

Preparation of the teeth and all the procedures were done as per standard protocol. Patients were scheduled for a check-up on the seventh day after surgery to assess sensitivity. They were told to mark the presence or absence of sensitivity on a Visual Analogue Scale (VAS 1–10) according to their reaction on exposure to cold and hot stimuli. Sensitivity was taken to be present if the VAS score was more than 3. In order to avoid bias, all procedures were conducted by the researcher herself. All the concerned data were collected using a structured proforma.

Data were entered and analyzed with SPSS version 22.0. Postoperative tooth sensitivity was compared between the two groups using the chi-square test, considering a p-value of ≤0.05 to be statistically significant. Data were stratified by gender, tooth location, age, and cavity depth to adjust for potential effect modifiers, and a post-stratification chi-square test was performed.

Results

The average age in group A was 39.53±11.60 years, whereas in group B it was slightly greater at 42.47±11.63 years. Group A contained a slightly greater percentage of females (70, 51.9%) than males (65, 48.1%), while Group B contained a greater number of males (77, 57.0%) than females (58, 43.0%). As to tooth location, molars were treated most often in both groups 77 (57.0%) for Group A and 79 (58.5%) for Group B. Most cavities in both groups had a depth of between 2.1 and 4.0 mm, with mean depths of 2.77±0.93 mm for Group A and 2.94±0.99 mm for Group B (Table 1). The VAS comparison of postoperative cold and hot sensitivity revealed no statistically significant differences between both groups. Group A (conventional composite resin) had mean sensitivity values of 1.80 ± 0.86 for hot and 1.72 ± 0.80 for cold, whereas Group B (Bulk-fill composite resin) had values of 1.84 ± 0.82 for hot and 1.90 ± 0.86 for cold. P values for hot and cold sensitivity were 0.718 and 0.070 respectively, suggesting no significant variation in postoperative thermal sensitivity between the two restorative materials (Table 2).

Table 3 shows the distribution of frequency of postoperative hot and cold sensitivity after conventional composite resin (Group A) and bulk-fill composite resin (Group B) restorations in Class I posterior cavities. Postoperative sensitivity to hot was found in 6 (4.4%) patients in Group A and 9 (6.7%) patients in Group B. Between the two groups, the difference was not significant (P = 0.425). Postoperative cold sensitivity was observed in 3 patients (2.2%) of Group A and in 9 patients (6.7%) of Group B, with a P-value of 0.076, reflecting that the difference was not significant. Most of the patients in both groups were not sensitive to thermal stimuli, reflecting that both restorative materials had similar clinical performance regarding postoperative sensitivity to hot and cold.

Stratification of postoperative hot sensitivity by age, gender, tooth position, and depth of the cavity between Group A (Conventional composite resin) and Group B (Bulk-fill composite resin) revealed no statistically significant correlations. In patients between 20 and 40 years, 7 (5.3%) felt hot sensitivity, and 8 (5.8%) between 41 and 60 years, with P-values of 0.455 and 0.708 respectively. As for gender, sensitivity was noted by 7 males (P = 0.086) and 8 females (P = 0.647). For tooth site, 5 cases were seen in premolars (P = 0.158) and 10 in molars (P = 0.967). As for the depth of cavities, 4 patients with shallow cavities (1.0–2.0 mm, P = 0.976) and 11 with deep cavities (2.1–4.0 mm, P = 0.343) felt sensitivity. These findings indicate that none of the stratified variables had a substantial effect on postoperative hot sensitivity between the two composite resin groups (Table 4).

The postoperative sensitivity to cold stratification with regard to age, gender, tooth position, and depth of cavity between Group A (Bulk-fill composite resin) and Group B (Conventional composite resin) showed no statistically significant differences. Within the 20–40 years age group, 5 (3.8%) patients experienced cold sensitivity (P = 0.093), whereas in the 41–60 years age group, 7 (5.0%) patients experienced it (P = 0.402). On the basis of gender, 7 males (P = 0.086) and 5 females (P = 0.501) felt sensitivity. Sensitivity was found in 5 (4.4%) premolar cases (P = 0.158) and 7 (4.5%) molar cases (P = 0.260). Regarding cavity depth, cold sensitivity was reported by only 1 patient (1.4%) with a shallow cavity (1.0–2.0 mm, P = 0.321) and 11 (5.5%) with deep cavities (2.1–4.0 mm, P = 0.117). In general, none of these factors was significantly correlated with postoperative cold sensitivity in either group (Table 5).

Table 1: Demographic profile of the patients and frequencies of different variables

Variables	Group-A (Conventional composite resin)		Group-B (Bulk-fill composite resin)	
	Number	Percentage	Number	Percentage
Age				
20-40	74	54.8	57	42.2
41-60	61	45.2	78	57.8
Total	**135**	**100.0**	**135**	**100.0**
Mean ± SD	**39.53±11.60**		**42.47±11.63**	
Gender				
Male	65	48.1	77	57.0
Female	70	51.9	58	43.0
Total	**135**	**100.0**	**135**	**100.0**

Location of teeth				
Premolar	58	43.0	56	41.5
Molar	77	57.0	79	58.5
Total	**135**	**100.0**	**135**	**100.0**
Cavity depth (mm)				
1.0 to 2.0	34	25.2	35	25.9
2.1 to 4.0	101	74.8	100	74.1
Total	**135**	**100.0**	**135**	**100.0**
Mean ± SD	2.77±0.93		2.94±0.99	

Table 2: Comparison of the sensitivity to hot on VAS and sensitivity to cold on VAS between two groups

Group	Postoperative sensitivity to hot on VAS	Postoperative sensitivity to cold on VAS	P value
	Mean±SD	Mean±SD	
(Conventional composite resin)	1.80±0.86	1.72±0.80	P=0.718
(Bulk-fill composite resin)	1.84±0.82	1.90±0.86	P=0.070

Table 3: Frequency of postoperative sensitivity after conventional composite resin restoration and bulk- fill resin composite restoration in class 1 cavity in posterior teeth

Sensitivity	Group-A (Conventional composite resin)		Group-B (Bulk-fill composite resin)		P value
	Number	Percentage	Number	Percentage	
Postop sensitivity to hot					
Present	6	4.4	9	6.7	P=0.425
Absent	129	95.6	126	93.3	
Total	135	100.0	135	100.0	
Postop sensitivity to cold					
Present	3	2.2	9	6.7	P=0.076
Absent	132	97.8	126	93.3	
Total	135	100.0	135	100.0	

Table 4: Stratification for age, gender, location and cavity depth with regard to postop sensitivity to hot

Postop sensitivity to hot		Group-A (Conventional composite resin)		Group-B (Bulk-fill composite resin)		Total
		Number	Percentage	Number	Percentage	
Age (Year)						
20-40	Present	3	42.9	4	57.1	7(100%)
	Absent	71	57.3	53	42.7	124(100%)
Total		74	56.5	57	43.5	131(100%)
P = 0.455						
41-60	Present	3	37.5	5	62.5	8(100%)
	Absent	58	44.3	73	55.7	131(100%)
Total		61	43.9	78	56.1	139(100%)
P = 0.708						
Gender						
Male	Present	1	14.3	6	85.7	7(100%)
	Absent	64	47.4	71	52.6	135(100%)
Total		65	45.8	77	54.2	142(100%)
P = 0.086						
Female	Present	5	62.5	3	37.5	8(100%)
	Absent	65	54.2	55	45.8	120(100%)
Total		70	54.7	58	45.3	128(100%)
P = 0.647						

Location of teeth						
Premolar	Present	1	20.0	4	80.0	5(100%)
	Absent	57	52.3	52	47.7	109(100%)
Total		58	50.9	56	49.1	114(100%)
P = 0.158						
Molar	Present	5	50.0	5	50.0	10(100%)
	Absent	72	49.3	74	50.7	146(100%)
Total		77	49.4	79	50.6	156(100%)
P = 0.967						
Cavity depth (mm)						
1.0 to 2.0	Present	2	50.0	2	50.0	4(100%)
	Absent	32	49.2	33	50.8	65(100%)
Total		34	49.3	35	50.7	69(100%)
P = 0.976						
2.1 to 4.0	Present	4	36.4	7	63.6	11(100%)
	Absent	97	51.1	93	48.9	190(100%)
Total		101	50.2	100	49.8	201(100%)
P = 0.343						

Table 5: Stratification for age, gender, location and cavity depth with regard to postop sensitivity to cold

Postop sensitivity to cold		**Group-A (Conventional composite resin)**		**Group-B (Bulk-fill composite resin)**		**Total**
		Number	**Percentage**	**Number**	**Percentage**	
Age (Year)						
20-40	Present	1	20.0	4	80.0	5(100%)
	Absent	73	57.9	53	42.1	126(100%)
Total		74	56.5	57	43.5	131(100%)
P = 0.093						
41-60	Present	2	28.6	5	71.4	7(100%)
	Absent	59	44.7	73	55.3	132(100%)
Total		61	43.9	78	56.1	139(100%)
P = 0.402						
Gender						
Male	Present	1	14.3	6	85.7	7(100%)
	Absent	64	47.4	71	52.6	135(100%)
Total		65	45.8	77	54.2	142(100%)
P = 0.086						
Female	Present	2	40.0	3	60.0	5(100%)
	Absent	68	55.3	55	44.7	123(100%)
Total		70	54.7	58	45.3	128(100%)
P = 0.501						
Location of teeth						
Premolar	Present	1	20.0	4	80.0	5(100%)
	Absent	57	52.3	52	47.7	109(100%)
Total		58	50.9	56	49.1	114(100%)
P = 0.158						
Molar	Present	2	28.6	5	71.4	7(100%)
	Absent	75	50.3	74	49.7	149(100%)
Total		77	49.4	79	50.6	156(100%)
P = 0.260						
Cavity depth (mm)						
1.0 to 2.0	Present	0	0	1	100.0	1(100%)
	Absent	34	50.0	34	50.0	68(100%)
Total		34	49.3	35	50.7	69(100%)
P = 0.321						
2.1 to 4.0	Present	3	27.3	8	72.7	11(100%)
	Absent	98	51.6	92	48.4	190(100%)

Total		101	50.2	100	49.8	201(100%)
P = 0.117						

Discussion

The findings of this study indicated that postoperative hot sensitivity was experienced by 4.4% of patients in Group A and 6.7% in Group B, whereas cold sensitivity was experienced by 2.2% and 6.7% of patients in Groups A and B, respectively. Statistical testing showed no statistical differences between the two groups for either hot (P = 0.425) or cold sensitivity (P = 0.076). These results indicate that both conventional and bulk-fill composite resins have similar clinical performance regarding postoperative thermal sensitivity in Class I posterior restorations.

These findings are in accordance with those of earlier research that has examined postoperative hypersensitivity related to various composite resin materials. Literature has indicated that bulk-fill composites, tailored for deeper cavities with less increment, perform clinically as equally as conventional composites regarding postoperative hypersensitivity. A research study examining the effect of preheating on bulk-fill resin composites discovered no negative influences on postoperative hypersensitivity.[3]Afifi et al comparing bulk-fill and nano resin composites showed no statistically significant difference in postoperative sensitivity when various adhesive approaches were utilized (11).

Postoperative sensitivity is a multi-factorial process determined by the extent of cavity preparation, adhesive system employed, polymerization shrinkage, and factors related to the patient. Although bulk-fill composites are designed to minimize polymerization shrinkage stress, their clinical behavior as far as sensitivity is concerned is similar to that of conventional composites (12). The results of this study corroborate the premise that both restorative materials are satisfactory in the aspect of postoperative sensitivity and can be safely used in practice (12). Bulk-fill composites designed to counteract polymerization shrinkage and stress by altering resin formulations and stepwise layering methods. Meta-analysis of 103 studies identified that bulk-fill materials have less volumetric shrinkage and cusp deflection (−18.6%−18.6%) than traditional composites, theoretically reducing risks of postoperative sensitivity (13). Nevertheless, the present study noted marginally increased cold sensitivity in Group B, indicating material properties per se may not universally determine clinical success. For example, flowable consistency bulk-fill composites have greater amounts of conversion at depths of more than 2 mm, which may unintentionally enhance interfacial stress in shallow cavities (14). This behavior may account for the increased cold sensitivity in Group B when restorations were placed into medium-depth preparations in which flowable composites have higher polymerization contraction (14).

The selection of adhesive system has a great impact on postoperative sensitivity. Although bulk-fill composites with self-etch adhesives present lower rates of sensitivity in certain studies (11). Total-etch adhesives, for instance, enhance dentinal tubule exposure, which increases fluid movement and susceptibility to sensitivity (15).

The result that the difference in hot hostility was not significant (p=0.425) shows that the thermal sensitivity of the two differences was almost the same. The lack of statistical significance in hot sensitivity (p=0.425) prohibit the materials from causing thermal irritation particularly equally. Nevertheless, the tendency of the cold sensitivity to be more in Group B (p=0.076) calls for attention to the issues of the technique. For instance, bulk-fill composites require adequate photo-activation for depth-dependent polymerisation; insufficient curing in deeper cavities can lead to marginal leakage and sensitivity.Moreover, preoperative sensitivity – a documented predictor of postoperative pain – was not accounted for in this study and thus could confound the findings. Clinicians must give preference to adhesive protocols that have a low dentinal fluid displacement, such as selective enamel etching or moisture-controlled bonding (15).

Conclusion

In conclusion, this study's results present that the postoperative hot and cold sensitivity of the teeth did not have any statistically significant difference between bulk-fill composite resin and conventional composite resin restorations in class I posterior cavities. Although more events of sensitivity were identified in the bulk-fill group, there was no noteworthy increase in sensitivity. Thus, those results reveal that both materials have alike outcomes for acute thermal sensitivity after treatment and this can be considered as a clinical recognition of the fact that bulk-fill composites are an efficient yet comfortable preservation alternative to conventional composite resins.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethical approval and consent to participate
Approved by the department concerned. (IRBEC-IMCC-24)
Consent for publication
Approved
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Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

TA (Postgraduate Residents)
Manuscript drafting, Study Design,
Review of Literature, Data entry, Data analysis, and drafting article.
AA (Professor)
Conception of Study, Development of Research Methodology Design,
MDA (Postgraduate Residents)
Study Design, manuscript review, critical input.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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