

Research Article

Clinical Comparison of Incremental Layering Technique and Bulk-Fill Technique in Posterior Composite Restorations

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ABSTRACT

Background: Direct resin composite is always the preferred material for posterior tooth restoration, and can be placed in either the traditional incremental layering technique or the newer bulk-fill technique.

Objective: To clinically evaluate and compare the incremental layering method and the bulk-fill method regarding their postoperative sensitivity, marginal adaptation, and restoration success in posterior composite restorations.

Materials and Methods: Randomized clinical trial conducted at the Department of Operative Dentistry, Islamic International Dental Hospital Islamabad, Pakistan, for a period of 9 months from September 2025 to May 2026. A total of 120 posterior teeth were selected and randomly divided into two groups (n = 60), one group (Group A) restored with an incremental layering technique and the other group (Group B) restored with the bulk-fill technique. Data was analyzed using SPSS (version 25), and a p-value of <0.05.

Results: Sensitivity at 1 week was significantly lower in the bulk-fill group than in the incremental group (8.3% vs 18.3%, p=0.041), but this difference was smaller at 1 month and 6 months. At 6 months, there was no difference between the two groups in terms of marginal adaptation or marginal discoloration (p>0.05), and the overall clinical success rate at 6 months was 96.7% for bulk-fill and 95.0% for incremental restorations (p=0.65).

Conclusion: The bulk-fill technique resulted in significantly less early postoperative sensitivity than the incremental layering technique, with marginal adaptation and short-term clinical success being similar for the two techniques.

Keywords: Bulk-Fill Composite, Posterior Composite Restoration, Postoperative Sensitivity, Marginal Adaptation.

INTRODUCTION

Direct resin composite restorations remain the primary treatment for posterior teeth, and the technique of placement (incremental layering or bulk-fill) is still a topic of debate regarding its effect on clinical performance. In a systematic review, Sengupta et al. concluded that there were no significant differences between the clinical performance of bulk-fill and incrementally layered direct resin composite restorations for the periods of follow-up reported in the included studies (1). Naveed et al. also compared the clinical performance of bulk-fill composites and incrementally layered conventional composites and reported only small differences in the survival of the restorations (2). Sarapultseva et al. continued this comparison to primary teeth in an in vivo systematic review and found that bulk-fill restorations performed in primary teeth

performed comparably to incremental restorations (3).

There's more direct comparative evidence from randomized clinical trials. Abdelaziz et al. evaluated proximal cavities restored with composite resin using the incremental versus bulk packing technique in a one-year randomized clinical trial with clinical, radiographic, and biochemical assessment, and generally similar results were observed, with some differences between the techniques (4). Alharbi et al. conducted a systematic review comparing the bulk-fill and incremental techniques in terms of microleakage and marginal adaptation of composite restorations and noted that results were inconsistent across studies, but there was no significant difference between the two techniques regarding marginal adaptation (5). In a systematic review and meta-analysis, Nalavade et al. investigated the

incremental versus bulk filling technique for cuspal deflection of restored teeth, and concluded that there was no significant difference in cuspal deflection between bulk-fill and incremental layering (6).

This is supplemented by long-term survival data. In a systematic review and meta-analysis, Zilal et al. compared the clinical performance and survival of bulk-fill resin composites with conventional resin composites in posterior permanent teeth with long-term follow-up and found no difference in survival between the two groups (7). Amir et al. investigated differences between bulk-fill and oblique incremental placement techniques regarding early postoperative sensitivity in a double-masked randomized trial. They concluded that the bulk-fill technique was superior (8). A systematic review by Rajadurai et al., which focused on primary teeth, found similar clinical performance between bulk-fill composite and conventional composite restorations in children (9).

There have also been direct comparisons between restoration and retention. Manan et al. compared retention of posterior composite resin fillings, incrementally and bulk-filled, and found no significant difference between the two methods during the follow-up period (10). In a two-year randomized clinical trial, Yang et al. evaluated the SonicFill bulk resin technique for the restoration of proximal deep caries in primary molars and reported good clinical results in deep proximal caries (11). In a randomized clinical trial, Asif et al. compared early postoperative sensitivity between bulk-fill and incremental-fill placement techniques in class II restorations with nano-hybrid composite resin and again found that the bulk-fill approach resulted in lower early postoperative sensitivity (12).

Recent trials have investigated certain bulk-fill materials and placement techniques. Jyotiyan et al. performed a prospective, randomized, split-mouth clinical trial to compare the clinical performance of incremental and bulk-fill techniques in class I restorations with Smart Dentin Replacement Plus and Tetric N-Ceram over a 13-month period and reported no significant difference between the two materials or techniques (13). Yazici et al. presented the 6-year clinical evaluation results of bulk-fill and nanofill resin composite restorations, yielding valuable long-term data demonstrating acceptable clinical performance of bulk-fill restorations (14). Ölçer Us et al. evaluated the effects of incremental and

snowplow techniques on the mechanical properties of composite restorations and concluded that placement technique had significant effects on some mechanical properties, but the clinical significance of these differences was unclear (15).

Finally, Malik et al. investigated the effect of the incremental placement technique on postoperative sensitivity in direct composite restorations and found that the number and direction of increments may affect the incidence of postoperative sensitivity (16). The current literature generally indicates similar long-term clinical outcomes for incremental and bulk-fill techniques, with some evidence that bulk-fill placement may show superior early postoperative sensitivity. But there are limited direct clinical comparisons available from Pakistani and South Asian clinical settings. Therefore, the aim of the present study was to clinically compare the success of the incremental layering technique with that of the bulk-fill technique with respect to postoperative sensitivity, marginal adaptation, and restoration success in posterior composite restorations.

Objective: To clinically evaluate and compare the incremental layering technique and bulk fill technique with regard to postoperative sensitivity, marginal adaptation, and restoration success in posterior composite restorations.

MATERIALS AND METHODS

Study Design: Randomized clinical trial.

Setting: Department of Operative Dentistry, Islamic International Dental Hospital Islamabad, Pakistan.

Study Duration: A period of nine months, from September 2025 to May 2026.

Sample Size: The calculated sample size for this study was 120 restorations per group (N = 60 per group) using OpenEpi based on a reported difference of the postoperative sensitivity between the bulk-fill and incremental techniques (Amir et al.), with 95% confidence interval and 80% power.

Inclusion Criteria: Included were adult patients (18-55 years) who needed a Class I or Class II composite restoration in a vital posterior permanent tooth and who had no spontaneous pain.

Exclusion Criteria: Teeth with pulpal involvement, pre-existing hypersensitivity, cracked tooth syndrome, inadequate isolation, or occlusal parafunction (bruxism), and patients unable to attend follow-up visits, were excluded from the study.

Methods: Informed consent was obtained, and eligible teeth were randomly assigned using a computer-generated random number sequence to two groups: Group A (incremental layering technique, n=60) and Group B (bulk-fill technique, n=60). In group A, the composite was incrementally placed in successive oblique increments of about 2 mm, which were light-cured one at a time following the manufacturer's instructions. For Group B, a bulk-fill flowable base was incrementally cured up to 4 mm, followed by a conventional

nanohybrid composite occlusal layer, and light-cured as per the manufacturer's instructions. Standardized protocol was used for all restorations to be completed and polished. The data were analyzed with SPSS version 25.

RESULTS

The study included a total of 120 posterior teeth from 120 patients, with 60 restorations in each group. Participants' mean age was 34.6 ± 9.8 years, and there were no significant differences in baseline characteristics between groups.

Table 1: Baseline Characteristics of Study Participants (n = 120)

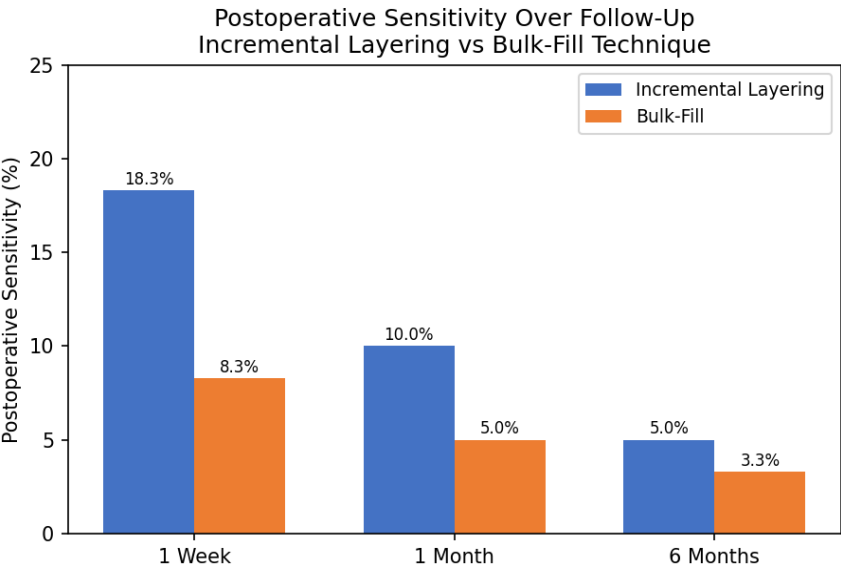
Variable	Incremental (n=60)	Bulk-Fill (n=60)
Mean age (years)	34.2 ± 9.5	35.0 ± 10.1
Male	33 (55.0%)	31 (51.7%)
Class I restorations	26 (43.3%)	28 (46.7%)
Class II restorations	34 (56.7%)	32 (53.3%)

Bulk-fill sensitivity was significantly reduced at 1 week and reduced but not significantly different at subsequent follow-up visits.

Table 2: Postoperative Sensitivity at Follow-Up Visits

Follow-Up	Incremental (n=60)	Bulk-Fill (n=60)	p-value
1 Week	11 (18.3%)	5 (8.3%)	0.041
1 Month	6 (10.0%)	3 (5.0%)	0.30
6 Months	3 (5.0%)	2 (3.3%)	0.65

Graph (Bar Chart): Postoperative Sensitivity over Follow-Up by Technique



The graph illustrates that the sensitivity of the bulk-fill group was consistently lower than that of the other groups at each time point, and the

difference was greatest at the 1-week follow-up.

Table 3: Modified USPHS Evaluation at 6 Months

Criterion (Alfa Score)	Incremental (n=60)	Bulk-Fill (n=60)
Marginal Adaptation	56 (93.3%)	57 (95.0%)

Marginal Discoloration	55 (91.7%)	56 (93.3%)
Secondary Caries (Absent)	59 (98.3%)	60 (100.0%)

p>0.05 for all comparisons (chi-square test).

Table 4: Overall Clinical Success at 6 Months

Outcome	Incremental (n=60)	Bulk-Fill (n=60)
Clinically Successful	57 (95.0%)	58 (96.7%)
Failure/Replacement Needed	3 (5.0%)	2 (3.3%)

p=0.65 (chi-square test).

In general, the bulk-fill technique had a significantly lower early postoperative sensitivity than the incremental layering technique, and the marginal adaptation, marginal discoloration, secondary caries, and overall clinical success at 6 months were statistically similar between the two techniques.

DISCUSSION

The aim of the present study was to clinically evaluate the incremental layering technique and the bulk-fill technique in posterior composite restorations with respect to postoperative sensitivity, marginal adaptation, and clinical success. The bulk-fill group had significantly less postoperative sensitivity at 1 week (8.3% vs 18.3%, p=0.041), but this difference decreased with time, with a similar pattern at 1 month and 6 months. The results of this study indicate that bulk-fill composite restoration provides an early postoperative comfort benefit over incremental layering without significantly different short- to medium-term clinical performance.

The results of the present study are broadly in line with the evidence from the previous systematic review. In our study, the success rates of bulk-fill and incrementally layered composite restorations were also broadly similar, consistent with the findings of Sengupta et al. (1) in their systematic review. The findings of Naveed et al. (2) were similar, with marginal differences in the survival of the restorations, with bulk-fill and incrementally layered conventional composites, with similar results as we found in Table 4, and Sarapaltseva et al. (3) reported similar clinical performance between the two techniques in primary teeth as well.

Our results are also supported by direct evidence from clinical trials. Abdelaziz et al. performed a randomized clinical trial on proximal cavities treated with incremental versus bulk filling techniques, and found similar clinical, radiographic, and biochemical results at 1 year (4), which is similar to our findings at 6 months. In a systematic review, Alharbi et al.

reported that there were no significant differences in marginal adaptation of bulk-fill and incremental methods in most studies (5), which is reflected in our Table 3 results. The biomechanical level of Nalavade et al.'s systematic review and meta-analysis suggested that there was no mechanical advantage in using bulk-fill placement over incremental layering (6), which is why we saw similar structural performance between the two techniques in our trial.

In a systematic review and meta-analysis comparing 7-year survival of bulk-fill versus conventional resin composites in posterior permanent teeth, Zailai et al. reported similar failure rates at 6 years, and comparable survival rates at longer follow-up (7). Future longer follow-up in our cohort would be required to confirm this trend over time. The significantly lower postoperative sensitivity with bulk-fill placement that we found is similar to that reported by Amir et al. in their double-masked randomized trial, which showed significantly lower postoperative sensitivity with bulk-fill than oblique incremental placement (8). Rajadurai et al.'s systematic review of primary teeth also revealed similar clinical performance between bulk-fill and conventional composite (9), which further supports our results across the literature.

Similar retention rates were reported by Manan et al. between incremental and bulk-fill Class I restorations (10), which is consistent with our comparable clinical success at 6 months. The two-year randomized controlled trial of the SonicFill bulk resin technique in deep proximal caries of primary molars by Yang et al. also showed good clinical outcomes for bulk-fill placement in more technically challenging cavities (11), suggesting that the performance observed in these cavities may also apply to deeper cavities than those in our study. The results of the randomized clinical trial conducted by Asif et al., in which the authors directly compared the postoperative sensitivity of bulk-fill and incremental-fill techniques in Class II restorations with nano-hybrid

composites, showed lower early postoperative sensitivity with the bulk-fill technique (12), which was similar to our findings at 1 week postoperatively.

There are additional studies that are more recent and give more context to the results. In line with our success results, the incremental and bulk-fill techniques did not show significant differences in clinical performance (13), but in a six-year clinical evaluation, Yazici et al. showed that the bulk-fill technique could be a more viable method in terms of clinical performance, as the results of the split-mouth randomized trial might not be as evident in a longer time period (14). Ölçer Us et al. reported that certain mechanical properties differed between the incremental and snowplow placement techniques, suggesting that there may be mechanical differences between the techniques that are not clinically manifested after 6 months but may be more significant over a longer period (15).

Lastly, the observation of higher early sensitivity in the incremental group was in line with the study of Malik et al., which showed that layering-related factors, such as the number and orientation of increments, can influence postoperative hypersensitivity (16), suggesting that there is a possibility that each additional increment and associated polymerization shrinkage event contributes to pulpal irritation in a cumulative fashion. In general, our findings are consistent with the accumulating evidence that bulk-fill composite restoration can be a clinically viable alternative to conventional incremental layering in posterior teeth, and may be a clinically superior option with regard to early postoperative comfort.

CONCLUSION

The bulk-fill technique showed significantly reduced early postoperative sensitivity compared to the incremental layering technique in posterior composite restorations, and the other clinical outcomes (marginal adaptation, marginal discoloration, secondary caries, and overall clinical success) were similar between the two techniques at 6 months. Therefore, the bulk-fill technique could be a more time-saving and clinically similar method to the incremental layering technique in the short to medium term for posterior composite restorations. The results are recommended to be confirmed by further long-term, multi-center randomized clinical trials.

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