

Comparison of Postoperative Sensitivity in Posterior Teeth Using Conventional and Bulk Fill Composites

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ABSTRACT

Objective: To compare and assess post-operative pain and sensitivity at 24 hours and 1 month in Class I restorations done with bulk-fill composite and conventional incremental layering technique.

Study Design: Randomized controlled trial (NCT06852586).

Place and Duration of Study: Operative Dentistry Department, Dental Section, 28 Military Dental Centre, Lahore Pakistan, from Aug to Nov 2022.

Methodology: A total of 70 patients requiring Class I composite restorations in molars were randomly assigned into two groups: Group-1 (bulk-fill composite) and Group-2 (incremental composite technique), with 35 patients each. Pain and sensitivity were assessed postoperatively at 24 hours and 1 month using a 0–10 numerical rating scale. Data were processed with SPSS version 20. Frequencies and percentages were determined for qualitative variables, whereas medians and interquartile ranges (IQR) were expressed for pain scores. Shapiro-Wilk test was employed in order to check data normality, and Mann-Whitney U test was applied for comparison between groups. A p -value of <0.05 was regarded as significant.

Results: At 24 hours, 46.83% of patients had no pain in Group-1 versus 70.89% at 1 month. The median score for pain at 24 hours was decreased in Group-1 [Median = 0 (IQR = 2)] versus Group 2 [Median = 1.5 (IQR = 4)], although this did not reach statistical significance ($p=0.121$). At 1 month, the median was 0 (IQR 1) in both groups with no statistical difference ($p=0.633$).

Conclusion: Both incremental and bulk-fill composite methods revealed similar results in terms of post-operative sensitivity and pain, and no differences were noted.

Keywords: Composite Resins, Dental Restoration, Tooth Sensitivity.

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INTRODUCTION

The esthetic, mercury-free requirement has promoted an increasing trend for the use of resin composites in posterior teeth. Postoperative sensitivity is still a major clinical issue that impacts patient satisfaction and restoration survival.¹ Postoperative sensitivity is caused by composite restorations through polymerization shrinkage, leading to marginal gap formation, microleakage, and dentinal fluid movement.² Postoperative sensitivity has been reported with varying frequency, from 10% to 30%, based on materials and techniques.³

Traditional nano-hybrid composites are generally inserted in 2 mm increments via the layering method for ideal polymerization.⁴ Nevertheless, it causes increased chair time and stress from multiple curing cycles.⁵ Bulk-fill composites, on the other hand, permit insertion in a single increment up to 4–5 mm through photo-initiators such as Camphorquinone, which increase depth of cure.⁶ They possess increased

translucency, optimal filler content, and decreased polymerization shrinkage, thereby potentially reducing the risk of postoperative sensitivity.⁷

Evidence indicates that bulk-fill composites might produce equivalent or even less sensitivity than traditional composites. Afifi et al. also recorded a 5% sensitivity for bulk-fill and 20% for nano-hybrid composites in 24 hours ($p<0.05$).⁸ Tardem et al., could not find any difference between the two (4.0% vs. 4.1%, $p>0.05$).⁹ Likewise, Cieplik et al., attested to the clinical durability of bulk-fill restorations in one year.¹⁰ Although adhesive approach is also involved, etch-rinse systems can enhance sensitivity through exposure of collagen fibers, while selective-etch adhesives can enhance bonding with reduced sensitivity.

Having limited data to directly compare postoperative sensitivity among mandibular molars restored with bulk-fill and conventional composites under standardized adhesive protocols, this research seeks to test and compare the onset and degree of sensitivity at 24 hours and one month post restoration. It is predicted that sensitivity between the two methods will not significantly differ. An under-

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standing of this association can help clinicians to choose the best restorative method to minimize postoperative pain and improve clinical results in posterior composite restorations.

METHODOLOGY

This double-blind randomized controlled clinical trial was carried out in 28 Military Dental Centre (MDC), Lahore Cantt, Pakistan for four months, from August to November 2022. Ethical approval was received from the institution's Ethical Review Committee (ERC reference# 107 OP-B/Trg/06/2022), and the study was registered with ClinicalTrials.gov (Protocol ID: NCT06852586). The initial sample size was determined by the G*Power software to detect a difference in postoperative sensitivity scores with an effect size of 0.25 (small to medium), with power 80% and significance level 5% (two-tailed), with a total of 52 participants. To account for the application of nonparametric statistical tests, 15% more samples were tested, which was 60 participants. Also, for allowing for a projected dropout rate of around 25%, the sample size was again increased to a final figure of 79 participants, with 39 being placed in the bulk-fill group and 40 in the incremental composite group. A non-probability convenient sampling method was utilized for enlisting patients who satisfied both the inclusion and exclusion criteria.

Inclusion Criteria: Patients with age range from 18- 55 years, male or female, mandibular molars with class 1 shallow-sized cavity with no history of pre-operative pain or sensitivity, ability to understand the use of sensitivity scale and adequate oral hygiene and willingness to participate in this study.

Exclusion Criteria: Patients with deep caries, associated with pain, had consumed any type of medication before treatment or any periapical infections were excluded from this study.

Informed written consent was sought after discussion of the study aims, procedures, and confidentiality guarantee. This research was performed with the double-blind model. The operator as well as the participants did not know which composite material type and adhesive system (self-etch or total-etch) were utilized. The two resin composites were supplied in the same color, alike in appearance and packing, and each material was marked with a particular code that only the data manager knew. The procedure was done without knowledge by the operator regarding the identity of the material. Randomization was done by employing a

computer-derived table of random numbers to allocate the participants into the two study groups. Allocation occurred after assessment of mandibular molars with class I caries that needed composite restorations. Measurement of the cavity depth was taken by a periodontal probe and was restricted to 3 mm. Pulp status of the tooth was checked by thermal tests of vitality: hot gutta-percha stick (Dentsply Sirona) was applied for heat test, and Ethyl Chloride spray (Endo Ice, Coltene) for cold test. Preoperative periapical radiographs were obtained to assess the depth of carious involvement and periapical or peri radicular pathology. Cavity preparation was performed under rubber dam isolation with a round diamond bur followed by copious rinsing with water to provide a clean field. The etching process was done by applying Coltene etchant gel for 30 seconds on the enamel surface, rinsing for 15 seconds, and drying until frosty appearance resulted. Coltene Magic Bond adhesive was applied for 20 seconds with rubbing motion and light-cured for a further 20 seconds with a Woodpepper LED curing unit. Patients suitable for inclusion were randomly assigned into two groups based on a table of random numbers. For examination of pulpal status, thermal tests with hot gutta-percha sticks and Ethyl Chloride spray, and preoperative periapical radiographs were done to assess caries extent and periapical tissues.

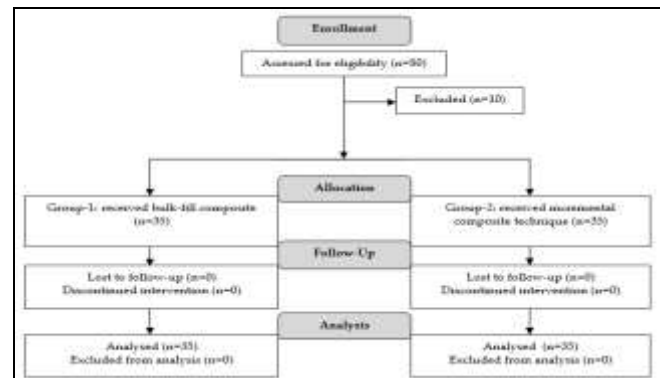


Figure: Phases of the study

All the procedures were carried out by one operator under rubber dam isolation. In Group-1, teeth were rehabilitated with the traditional oblique incremental technique with nano-hybrid composite (Coltene Brilliant NG) with each layer not more than 2 mm. In Group-2, teeth were restored with one 3 mm increment of dual-cure bulk-fill composite (Coltene Fill-Up). Patients were provided with a questionnaire that included an 11-point Numerical Rating Scale

(NRS), from 0 (no pain) to 10 (worst possible pain), for postoperative sensitivity to be self-assessed after 24 hours and 1 month. The NRS is a widely used, validated scale for measuring acute dental pain due to its ease and consistency. The demographic information was documented comprising of age, gender, and tooth number. Age was also stratified in groups (20-29, 30-39, 40-49 and 50-60 years).

Data was entered and analyzed using Statistical Package for Social Sciences (SPSS) version 20. Descriptive statistics were employed to describe the data. Frequencies and percentages for categorical variables like age group, gender, number of treated teeth, and type of composite material used were determined. For the continuous variable, postoperative sensitivity and pain score – median and interquartile range (IQR) were determined because it was found to have a non-normal distribution. Shapiro-Wilk test was used to check for normality of pain and sensitivity scores at 24 hours and 1 month, and these were both non-normally distributed ($p < 0.001$). Since the data breached normality assumptions, the non-parametric Mann-Whitney U test was employed to analyze the pain and sensitivity scores of the two groups (conventional vs. bulk-fill composite) at both time points (24 hours and 1 month). A p -value ≤ 0.05 was deemed statistically significant.

RESULTS

Our study sample comprised of 58.2% men and 41.8% women. Table-I depicts the demographic details of the patients, of the 79 patients treated, the age group most treated was 30–39 years (44.3%). Tooth #46 was treated most often (30.4%), followed by #36 and #47 (24.1% each), and #37 (21.5%). Composite types were almost equally utilized, with 50.6% bulk-fill and 49.4% conventional restorations. Table-II depicts the postoperative pain and sensitivity scores at two time points at 24 hours and 1 month following the procedure. Scores were between 0 (no pain/sensitivity) and 10 (severe pain/sensitivity), and for each score, frequencies and percentages (n, %) are presented. There is a significant decrease in higher scores at 1-month follow-up, with 70.89% of patients recording a score of 0 versus 46.83% at 24 hours, suggesting that there is a general improvement in postoperative discomfort with time.

Table-III illustrates the median postoperative pain and sensitivity scores (with interquartile range, IQR) in Group-1 and Group-2 at two time points: 24

hours and 1 month. Group-1 presented with a reduced median score (0) at 24 hours compared to Group-2 (1.5), although this was not found to be statistically significant ($p=0.121$). Both groups at 1 month had no difference in median scores of 0 ($p=0.633$), which implies equivalent pain relief over time in both groups.

Table-I: Demographic Characteristics, Distribution of Treated Tooth and Type Of Composite Used Among Study Participants (n=79)

Variable(s)	Categories	n(%)
Age(years)	20-29	19(24.1%)
	30-39	35(44.3%)
	40-49	18(22.8%)
	50-60	7(8.9%)
Gender	Male	46(58.2%)
	Female	33(41.8%)
Tooth number	36	19(24.1%)
	37	17(21.5%)
	46	24(30.4%)
	47	19(24.1%)
Types of Composites	Conventional	39(49.4%)
	Bulk fill	40(50.6%)

Table-II. Distribution of Postoperative Pain and Sensitivity Scores at 24 Hours and 1 Month (n=79)

Score	Pain and Sensitivity at 24 hours, n(%)	Pain and Sensitivity at 1 month, n(%)
0	37(46.83)	56(70.89)
1	11(13.92)	12(15.19)
2	8(10.13)	1(1.27)
3	6(7.59)	1(1.27)
4	6(7.59)	3(3.79)
5	1(1.27)	5(6.32)
6	3(3.79)	0(0)
7	4(5.06)	0(0)
8	2(2.53)	1(1.27)
9	1(1.27)	0(0)
10	0(0)	0(0)

Table-III: Comparison of Postoperative Pain and Sensitivity Scores among Groups at 24 Hours and 1 Month (n=79)

Time Interval	Groups		p-value
	Group-1 n=39 Median (IQR)	Group-2 n=40 Median (IQR)	
Pain and Sensitivity at 24 hours	0 (2)	1.5 (4)	0.121
Pain and Sensitivity at 1 month	0 (1)	0 (1)	0.633

DISCUSSION

In our research, most patients had minimal or no postoperative pain and sensitivity after Class I composite restorations. At 24 hours, 46.83% had no symptoms (score 0) which greatly improved to 70.89%

at 1 month. Whereas Group-1 had a median of 0 (IQR: 2) compared to Group-2 with 1.5 (IQR: 4) at 24 hours, the difference was not significant ($p=0.121$), and the groups equaled out at 1 month (median =0; $p=0.633$).

These results are in line with other studies.¹⁰ Sengupta et al. in a systematic review of 11 RCTs had stated that postoperative sensitivity was nil in 72–95% of patients treated with bulk-fill composites and that no difference was noted with the conventional composites at 24 hours and 1 month ($p>0.05$).¹¹ Conversely, Ibrahim et al. indicated that bulk-fill composites were 91.7% successful at 6 months regarding marginal adaptation and low frequency of postoperative sensitivity (6.7%), statistically no different from conventional composites ($p=0.832$).¹² Martínez-Sabio *et al.*, documented no significant difference between microleakage for Filtek™ bulk-fill and Activa™ bioactive restorative (1.2 ± 0.3 and 1.3 ± 0.4 mean dye penetration scores, respectively; $p>0.05$), validating that sealing capability and thus postoperative sensitivity was equal.¹³ Elhejazi *et al.*, also noted that the bulk-fill composites had better depth of cure (mean: 4.3 mm) than the conventional resins (mean: 2.6 mm; $p<0.001$), but this benefit was not reflected in a statistically significant decrease in reported sensitivity ($p=0.529$).¹⁴ Yollar *et al.*, also highlighted that selective enamel etching significantly minimized microleakage ($p<0.05$) irrespective of the composite material, indicating the adhesive regimen could play an even more important role in post-operative symptomatology than the material itself.¹⁵

Our results are consistent with those of Çağırır Dindaroğlu and Yılmaz, who contrasted the use of a nano-hybrid with that of a bulk-fill composite and noted that the postoperative sensitivity tended to reduce over the long term in both groups.¹⁶ They cited 68% of the teeth restored using bulk-fill composites as having no sensitivity after 7 days, which rose to well over 85% by the 1-month period which is similar to our finding of 70.89% at 1 month. Likewise, Par *et al.*, evaluated marginal integrity with rapid high-intensity light curing and reported that marginal integrity was dependent on the curing protocols, but no meaningful increase in patient-perceived sensitivity was identified with bulk-fill compared to conventional composites.¹⁷ This finding is consistent with the similar postoperative comfort between the two groups of our study. The meta-analysis of Kunz *et al.*, also supports our evidence, with no clinically significant difference in clinical outcomes, including postoperative

sensitivity, between incremental fill and bulk-fill techniques.¹⁸ Postoperative sensitivity was low and clinically indistinct between methods within 12 randomized trials in their review, corroborating our findings with statistically non-significant differences in sensitivity at both time points.

LIMITATION OF STUDY

One of the main limitations of this research is the comparably short follow-up time of one month, which will not necessarily reflect long-term postoperative sensitivity or failure to restore. Secondly, despite an effort to blind and standardize the participants and procedures, full removal of operator and patient bias is challenging in a clinical environment. The subjective scoring for pain, although frequent, can also potentially cause variation between patient responses. Additionally, the sample size, while statistically warranted, can limit the results' generalizability to a wider population.

CONCLUSION

The research concludes that both bulk-fill and traditional nano-hybrid composite restorations have similar results regarding postoperative pain and sensitivity. The lack of statistically significant differences at 24 hours and one month after the procedure indicates that either method can be applied efficiently in clinical practice if proper clinical protocols are employed. Increased longitudinal studies with larger cohorts and longer follow-up periods are suggested to support these results.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

ZZ & IK: Data acquisition, data analysis, critical review, approval of the final version to be published.

JS & SR: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

TS: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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