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Effect of Rebonding Technique on Post-Operative Hypersensitivity in Composite Restorations: A Randomised Controlled Trial

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ABSTRACT
OBJECTIVE: To compare post-operative sensitivity in composite restorations placed with and without rebonding technique using self-etch adhesive.
METHODOLOGY: This randomized controlled trial was conducted at the Operative Dentistry Department of Foundation University College of Dentistry & Hospital, Islamabad, from July to October 2025. Seventy-eight patients with class-1 carious lesions extending up to the middle third of dentin were randomly allocated to either the rebonding group or the conventional treatment group. Post-operative sensitivity was assessed using the Numeric Pain Intensity Scale at 24 hours and 7 days. Data were analyzed using SPSS version 22.
RESULTS: There was no statistically significant difference in baseline age (Median = 21.00; p = 0.108) or gender distribution (p = 0.282) between the groups. The rebonding group had significantly lower post-operative pain scores at 24 hours than the conventional group (p = 0.045). At 7 days, the rebonding group showed a lower frequency of pain (2.6% vs 7.7%), although the difference was not statistically significant (p = 0.290).
CONCLUSION: Patients in the rebonding group showed significantly less immediate post-operative sensitivity in comparison with the conventionally treated composite restorations at the 24-hour follow-up (p = 0.045). Rebonding may serve as a practical and effective adjunct to improve patients' comfort following composite restorations.
Trial Registration: *https://clinicaltrials.gov/study/NCT07041424*

KEYWORDS: Composite resins, Dentin bonding agents, Dental leakage, Dental restoration, Dentin sensitivity

INTRODUCTION

Composite resins have become the preferred material for direct restorations because of their micromechanical retention, better aesthetics, and potential for more conservative restorations[1]. However, despite advances in their properties, post-operative sensitivity remains a significant disadvantage of composite resins[2]. Post-operative sensitivity in composite restorations can occur due to microleakage following bond disruption due to curing shrinkage or traumatic finishing procedures[3-5]. According to the literature, about 30% of patients reported post-operative sensitivity after posterior composite restoration[2], a significant clinical indicator of restoration failure[6].

Several strategies have been proposed to minimize post-operative sensitivity, such as pulse delay mode for curing, use of desensitizers, use of flowable composite as a liner, use of low shrinkage composites, and use of wet bonding techniques[7]. Rebonding is one such technique suggested to address this issue[8]. Rebonding involves application of an unfilled resin over the margins of restoration after finishing and polishing. Resin infiltrates into marginal gaps by capillary action, blocks surface defects and minimizes microleakage[9].

Multiple in-vitro studies suggest that rebonding can reduce microleakage in composite restorations. A study by Fatima N 2019[9] showed that acid etching or rebonding reduced microleakage by 91.7%. Several reviews have also suggested rebonding is effective in reducing microleakage[1,10]. However, limited studies have examined the clinical effects of rebonding on post-operative hypersensitivity. Previous studies have mainly investigated surface sealants or conventional adhesive systems as rebonding agents[13,1,3,12].

In contrast, use of universal bonding agents for rebonding has received little clinical attention. Universal bonding agents contain the functional monomer 10-MDP (10-Methacryloyloxydecyl dihydrogen phosphate), which forms a stable chemical bond with hydroxyapatite, potentially improving the marginal adaptation and reducing microleakage[13]. Furthermore, using the same bonding agent for rebonding offers significant practical advantages, such as cost-effectiveness and simplified technique. This study aims to investigate the effectiveness of rebonding in reducing post-operative hypersensitivity in composite restorations placed with self-etch adhesive.

METHODOLOGY

The randomized controlled trial was conducted at the Operative Dentistry Department of Foundation University College of Dentistry and Hospital (FUCD & H), Islamabad, Pakistan, from July to October 2025, after approval from the Ethics Review Committee of (FUCD & H), Islamabad, Pakistan, vide letter FF/FUCD/632/ERC/68 dated 19 Sep, 2024 and trial registration at clinicaltrials.gov (trial registration number: NCT07041424). This study was structured following the CONSORT guidelines. **Figure 1**

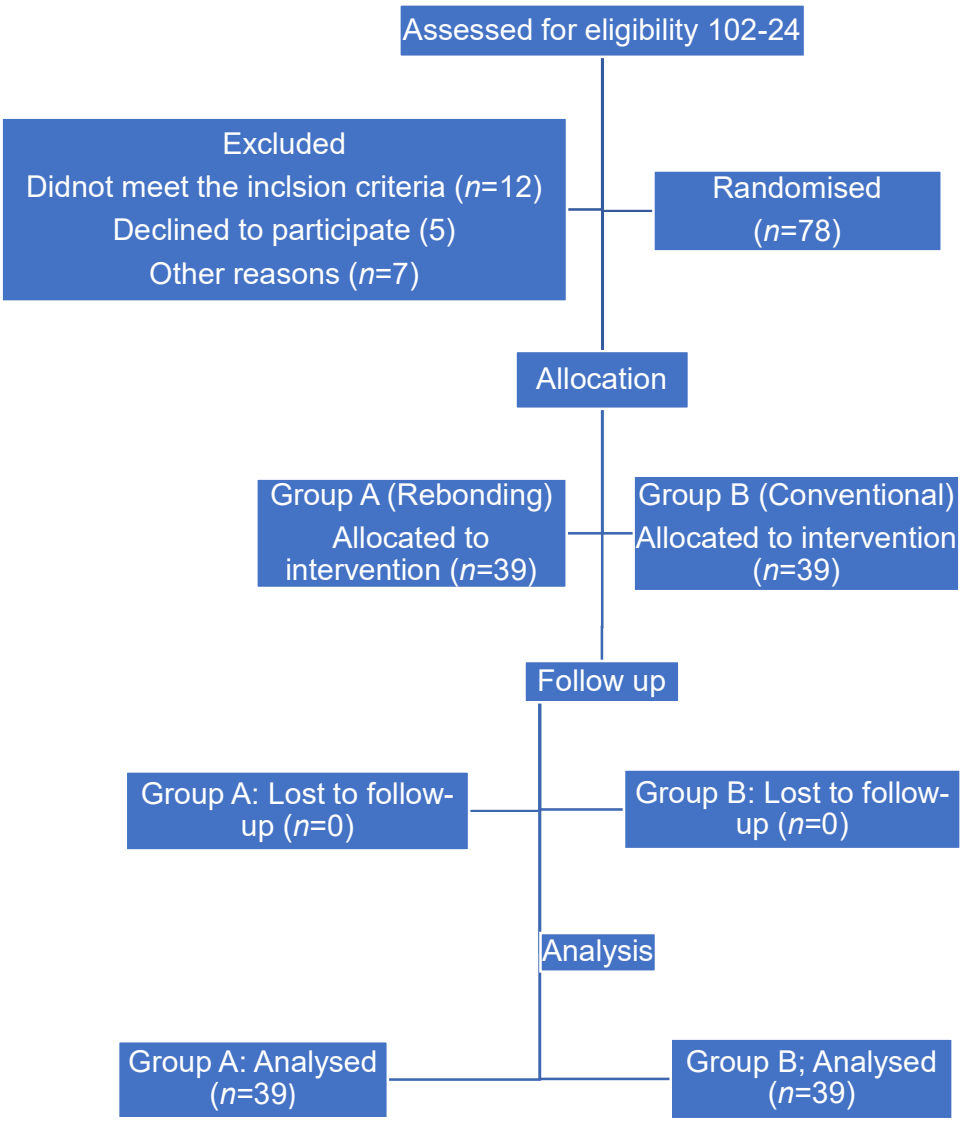


Figure 1: Consort flow diagram showing participant eligibility, allocation and analysis (n=78)

A pilot study was conducted of calculate the sample size. We treated and followed of 26 patients (13 per group) to record pain scores. Using the WHO sample size calculator for comparison of two independent means, with a two-sided significance level (α) of 0.05, statistical power of 80%, and allocation ratio of 1:1, the minimum required sample size was calculated to be 60 participants (30 per group). To compensate for an anticipated 30% loss to follow-up, the sample size was increased to 78 participants. The study was double-blind; patients and the statistician were blinded to the actual treatment allocation. Due to the nature of the intervention, the operator was not blinded.

Patients of either gender, aged 18 to 28 years, reporting to the Operative Dentistry Department with Class I carious lesions on premolar or molar teeth were included until the required sample size was achieved. After verbal explanation of the procedure, written informed consent was obtained from all patients. Participation was entirely voluntary, and refusal to participate did not affect patients' treatment. A pre-operative periapical radiograph was taken to assess the depth of caries. Moderate depth occlusal carious lesions extending up to the middle third of dentin were included in the study. We evaluated vitality status after thermal testing of teeth to exclude teeth with a history of spontaneous pain or signs and symptoms of pulpal necrosis and irreversible pulpitis. Patients with generalized sensitivity, bruxism, poor periodontal health, and a history of analgesic or anti-inflammatory medication use, which could mask the postoperative pain result, were excluded. Participants were randomly allocated to either the rebonding or conventional treatment group using simple lottery-based randomization.

A single operator carried out all cavity preparations and restorations. In both groups, the cavity preparation was conducted with a round bur in a high-speed handpiece followed by excavation of the carious lesion. Cavities in both groups were treated with selective etching of enamel using Meta Etchant (Meta Biomed Co., Ltd., Cheongjua, South Korea) for 15 seconds, followed by rinsing and air drying. Universal bonding agent (Ivoclar Vivadent; Schaan, Liechtenstein) was applied to etched enamel and unetched dentin. The cavity was restored with the nanohybrid composite resin (Ezfil, Meta Biomed Co., Ltd, Cheongjua, South Korea) using an incremental technique. Finishing of the restoration was done with flame-shaped diamond burs. In group 1, a universal bonding agent was applied to the restoration margins and light-cured using Bluephase PowerCure (Ivoclar Vivadent, Schaan, Liechtenstein) for 20 seconds. In group 2, no further treatment was provided after finishing. We evaluated restored teeth from both groups for sensitivity after 24 hours and 1 week post-operatively. Participants were instructed to contact the investigator of they experienced severe pain. Tablet paracetamol 500mg was prescribed only when required, and any analgesic consumption was recorded.

Data were analyzed with SPSS version 22. Pain scores between the groups were compared using the Mann-Whitney *U* test. A *p-value* of 0.05 was considered statistically significant.

RESULTS

A total of 78 patients were included in the study (n = 39 each). Comparison of baseline characteristics of both groups showed no significant difference (**Table I**). Because age was not normally distributed in the rebonding group (p = 0.001), we used the Mann-Whitney U test, which showed no statistically significant difference between the groups (p = 0.108). Post-operative pain scores were analyzed using the Mann-Whitney U test due to the non-normal distribution of the data (Shapiro-Wilk, $p < 0.001$). (**Table II**).

At 24 hours, the rebonding group had significantly lower pain levels (Mean Rank 36.95) than the conventional group (Mean Rank 42.05; U = 661.0, p = 0.045). In terms of frequency, 15.4% (n = 6) of patients in the conventional group reported pain, whereas 2.6% (n = 1) of the rebonding group reported pain.

At 7-day follow-up, the difference between the two groups was not statistically significant (Mean Rank 38.46 vs 40.54, U = 720.0, p = 0.290). However, pain frequency decreased to 7.7% (n = 3) in the conventional group, while it remained at 2.6% (n = 1) in the rebonding group. Within-group pain reduction from 24 hours to 7 days did not reach statistical significance (Wilcoxon signed-rank test, Z = - 1.857, p = 0.063).

Table I: Baseline Characteristics of study participants (*n* = 78)

Variable	Rebonding technique (*n*=39)	Conventional technique (*n*=39)	*P* - value
Age (years), median (IQR)	21.00 (5.00)	21.00 (5.00)	0.108[a]
Gender Male, *n* (%) Female, *n* (%)	 7 (17.9%) 32 (82.1%)	 11 (28.2%) 28 (71.8%)	0.282[b]

[a]*Mann-Whitney U test*
[b]*Chi square test*
IQR = Interquartile Range

Table II: Comparison of post-operative pain between the study groups

Time Point	Rebonding technique (n = 39)	Conventional technique (n = 39)	p-value
24 hours	36.95	42.05	0.045*
7 days			
	38.46	40.54	0.290

Values are presented as mean ranks.
Mann-Whitney U test
$p < 0.05$ was considered statistically significant.
A lower mean rank indicates lower reported post-operative pain scores.

DISCUSSION

This study aimed to evaluate the role of rebonding in reducing post-operative pain/sensitivity in composite restorations placed with self-etch adhesive. Patients who received rebonding after composite restoration placement showed significantly lower post-operative sensitivity.

Post-operative sensitivity is commonly associated with Class I and Class V composite restorations, due to high configuration factor (C-Factor)[14,15]. A high C-Factor increases internal stress that is generated during polymerization shrinkage, breaching the marginal seal and leading to microleakage[14-16]. Microleakage usually becomes clinically evident only when symptoms such as marginal staining or post-operative sensitivity appear[12].

Rebonding in composite restorations plays a crucial role in improving the marginal seal, reducing microleakage, increasing wear resistance[17], and enhancing their overall longevity[8,18]. Filled or unfilled, visible light-cured (VLC) resins have been proposed for rebonding. Numerous low-viscosity resins, known as surface sealers, have also been introduced and evaluated for their efficacy in reducing microleakage[8]. Unlike previous studies that relied on filled or unfilled resin specifically designed for resealing restorations, our study used the same universal adhesive used to bond the restoration as an additional margin sealer after finishing. The low incidence of post-operative sensitivity was observed in patients treated with rebonding; hence, the same adhesive used for placing the restoration can be considered a viable option for sealing the margins of the restoration (rebonding).

A study by Tekçe et al.11 compared two self-etch bonding agents, with and without surface sealant application, across four groups of 11 patients each. In their study, controlled stimulation tests such as cold air, ice, and pressure were applied to evaluate post-operative sensitivity. Some level of sensitivity was reported in all groups at 24 hours and 7 days[11]. These results contrast with the outcomes of the present study, where reduced post-operative sensitivity was observed during follow-up. This may reflect differences in the evaluation criteria used in the two studies. Tekçe et al.[11] focused on stimulation-based tests, whereas the current study emphasized patient-reported symptoms during daily activities, such as the consumption of hot and cold foods and beverages. Evaluating patient-reported symptoms offers a more practical approach in assessing functional sensitivity.

The current study focused solely on moderate cavities, which may have led to the more predictable outcomes observed, as deeper cavities may lead to pulpal inflammation and pain[8]. In contrast, Tekçe's study11 included shallow, medium, and deep cavities.

Furthermore, the present study limited follow-up to 24 hours and 7 days, while Tekçe et al.[11] assessed at 24 hours, 7 days, and 30 days post-treatment. A one-week follow-up is considered adequate for early post-operative sensitivity assessment as it tends to peak during the first week after restoration and gradually subsides thereafter[19,20].

Although Tekçe et al.[11] reported minor variations in outcomes, their results did not reach statistical significance, likely because of the smaller sample size. This limits the generalizability of their findings, which may partly explain why the present study observed more consistent outcomes.

This study highlights the clinical benefit of rebonding in providing immediate relief from post-operative sensitivity. At 24 hours, only 2.6% of patients in the rebonding group reported pain compared to 15.4% in the conventional group. This immediate reduction is clinically significant because it addresses the 24-hour period when patients are most prone to sensitivity after composite restoration placement[13,21]. Moreover, a universal bonding agent was used in the present study due to its versatility across different etching modes and its ability to minimize technique sensitivity. The effective marginal sealing provided by a secondary layer (rebonding) can be attributed to the presence of 10-MDP (10-Methacryloyloxydecyl dihydrogen phosphate) in the universal bonding agent. Studies show that 10-MDP, a functional monomer, forms a highly insoluble ionic bond with the calcium salt of

hydroxyapatite. Additionally, reduced leakage on enamel margins can be explained by the strong interaction between 10-MDP and enamel, owing to the high mineral content of enamel[20,13,21].

Our findings highlight the significance of a comprehensive approach to reduce the incidence of post-operative hypersensitivity. In addition to rebonding, proper diagnosis and case selection, careful tooth preparation, optimal isolation, incremental technique, and adequate use of an adhesive system are critical factors that must be considered collectively to achieve optimal outcomes and minimize sensitivity[8].

The lack of previously published data restricts the direct comparison with existing literature. Limitations of this study include a single operator performing all the procedures in a controlled setting with a small sample size. This limits the generalisability of outcomes to wider ranges of clinical settings and clinicians' expertise. Post-operative sensitivity was based on patient self-reporting rather than objective thermal testing. Future studies should include direct thermal tests to confirm these findings.

Furthermore, long-term effects such as secondary caries, staining, and late-onset sensitivity could not be assessed due to the shorter follow-up period. There is also a need to evaluate the effects of rebonding in other cavity configurations, such as class V, and to compare the performance of different materials, such as etch-and-rinse adhesives and surface sealants. While the current results are promising, long-term, multicenter clinical trials with larger cohorts are needed to consolidate these results and support rebonding as a clinically useful adjunct.

CONCLUSION

The rebonding technique significantly reduced immediate post-operative sensitivity compared with the conventional methods. Although the benefit was more evident at the 24-hour follow-up, rebonding may serve as a practical and effective adjunct for improving patients' comfort following composite restorations.

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Data Sharing Statement: The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

AUTHOR CONTRIBUTION

Habiba U: Literature review, data collection and entry, implementation of research, drafting and writing, record keeping, treatment

Aman N: Concept and design, statistical analysis, interpretation of data, critical analysis, revision, final approval

Khan M: concept and design, critical analysis, revision, final approval

Ahmed N: Statistical analysis, interpretation of data revision

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