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ORIGINAL ARTICLE

Comparison of Post-Operative Sensitivity in Composite Restoration Using Total Etch and Self Etch Dentine Adhesives

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ABSTRACT

Background: Post-operative sensitivity remains a common clinical concern in composite restorations, often influenced by the type of dentin adhesive used.

Objective: To compare post-operative sensitivity in composite restorations using total-etch and self-etch dentin adhesive systems.

Methodology: A randomized controlled trial was conducted in the Department of Operative Dentistry, Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro, over a six-month period. A total of 242 patients aged 15–60 years with Class I carious lesions were recruited and randomized into two groups: Group A (n = 121) received restorations using a total-etch adhesive system, and Group B (n = 121) received restorations with a self-etch adhesive system. Post-operative sensitivity was assessed at 1, 2, and 4 weeks using a Visual Analogue Scale (VAS) and clinical sensitivity tests (cold, hot, and bite). Data were analyzed using SPSS version 20, with chi-square applied for categorical comparisons.

Results: Out of 242 patients, 232 (95.90%) completed follow-up. At final evaluation, overall 70.70% reported no sensitivity, while 29.31% experienced post-operative sensitivity. In the total-etch group, 42.90% of patients reported sensitivity compared to only 15.0% in the self-etch group, a statistically significant difference ($p < 0.00001$). Cold sensitivity was the most frequent trigger, particularly during the first week, and gradually decreased over time in both groups. No significant associations were found with gender, age, or tooth type.

Conclusion: Self-etch adhesive systems demonstrated superior performance in reducing post-operative sensitivity compared to total-etch systems.

Keywords: Post-operative sensitivity, composite restoration, total-etch adhesive, self-etch adhesive.

INTRODUCTION

Advances in adhesive dentistry have revolutionized restorative procedures by enabling minimally invasive cavity preparations, improved esthetics, and long-term durability of restorations[1]. Composite resins, bonded through adhesive systems, have become the material of choice for both anterior and posterior restorations due to their superior mechanical and esthetic properties[2]. However, one of the most persistent clinical challenges associated with composite restorations is post-operative sensitivity, which can compromise patient comfort and affect the overall success of treatment[3].

Dentin adhesives are fundamental in establishing a reliable bond between composite resin and tooth substrate[4,5]. Over the years, adhesive systems have evolved from multi-step procedures to simplified protocols, with the goal of reducing technique sensitivity and improving clinical outcomes[6]. Two widely used approaches are the total-etch system, which involves the separate application of phosphoric acid to demineralize enamel and dentin before adhesive placement, and the self-etch system, where acidic primers simultaneously condition and infiltrate the tooth substrate without the need for rinsing[7].

While the total-etch technique is considered the gold standard for achieving strong enamel bonds, it has been associated with postoperative complications, particularly when over-etching or incomplete resin infiltration into demineralized dentin occurs[8,9]. This can lead to incomplete sealing of dentinal tubules, resulting in fluid movement and postoperative sensitivity[10]. On the other hand, self-etch adhesives reduce the risk of over-etching by partially demineralizing the dentin and simultaneously incorporating residual hydroxyapatite into the hybrid layer[11]. Although this approach may decrease sensitivity and improve patient comfort, concerns have been raised regarding its comparatively lower enamel bond strength[12].

Clinical studies have reported conflicting findings regarding which adhesive system results in lower postoperative sensitivity. Variations in adhesive composition, clinical techniques, cavity depth, and patient factors contribute to this inconsistency. Given the importance of patient comfort and the longevity of composite restorations, a direct comparison between total-etch and self-etch adhesives is essential to guide clinicians in selecting the most appropriate bonding strategy.

Research Objective: To compare the post-operative sensitivity in composite restoration using self-etch and total-etch dentin adhesive.

METHODOLOGY

Study Design and Setting: This study was designed as a single-blind randomized controlled research conducted in the Operative Dentistry Department of Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro. The research was carried out over a period of six months, beginning on April 1, 2019, and concluding on October 1, 2019.

Inclusion and Exclusion Criteria: Patients of either gender, aged between 15 and 60 years, presenting with Class I carious lesions in premolars and molars with a medium cavity depth of 2 mm, and with intact opposing and adjacent contacts, were included in the study. Exclusion criteria were applied to patients with deeper carious lesions exceeding 2 mm in depth, cases where rubber dam isolation was not possible, or those presenting with non-carious tooth surface loss due to attrition, abrasion, or erosion. Additionally, patients with fractured or cracked teeth, temporomandibular joint disorders, gingival recession with root exposure, or pre-existing tooth sensitivity were excluded. All exclusion criteria were confirmed through clinical examination and radiographic evaluation.

Sample Size Selection and Randomization Process: A total of 242 patients were included in the study, with 121 participants allocated to each group. The sample size was determined using WHO sample size software, based on anticipated population proportions of 16% for the total-etch group and 6% for the self-etch group, with an alpha level of 5% and a power of 80%. Patients were recruited using a non-probability consecutive sampling

technique, and randomization was performed through a sealed opaque envelope method to ensure allocation concealment. Group A was treated with a total-etch adhesive system (Adper Scotchbond, 3M ESPE), while Group B received a self-etch adhesive system (Adper Prompt L-Pop, 3M ESPE), with 121 participants in each group

Clinical Procedure: All clinical procedures were performed by the principal investigator under the supervision of a senior faculty member, following standardized protocols. After caries removal using a round diamond bur, cavity depth was confirmed with a periodontal probe and periapical or bitewing radiographs. In both groups, composite resin (3M™ ESPE™ Filtek™ Z250 Universal Restorative) was used as the restorative material. In Group A, teeth were etched with 34% phosphoric acid for 15 seconds, rinsed for 20 seconds, lightly dried to maintain a moist dentin surface, and then treated with the total-etch adhesive according to manufacturer's instructions. In Group B, the self-etch adhesive was applied directly to enamel and dentin surfaces as instructed by the manufacturer. Restorations were light-cured with an LED curing unit (Dentsply, Caulk).

Data Collection and Follow-Up and Outcome Assessment: All data, including baseline information, treatment details, and follow-up findings, were recorded on predesigned proformas. Patients were recalled for evaluation at one, two, and four weeks following the restoration procedure. Postoperative sensitivity was assessed using both patient-reported outcomes and clinical tests. Patients recorded sensitivity levels on a 0–10 cm Visual Analogue Scale (VAS). Cold sensitivity was tested using Endo-Ice spray applied with a cotton pellet to the buccal surface for up to five seconds, while hot sensitivity was evaluated using heated gutta-percha or hot water. Bite sensitivity was tested using the Tooth Slooth device. In each case, sensitivity scores were classified as 0 (no sensitivity), 1–3 (mild sensitivity, negative), or 4–10 (strong or unbearable sensitivity, positive, requiring restoration removal if necessary).

Statistical Analysis: Data analysis was performed using SPSS version 20 (IBM, USA). Continuous variables, such as age and sensitivity scores, were presented as mean ± standard deviation, while categorical variables, including gender and sensitivity presence, were reported as frequencies and percentages. Potential effect modifiers such as age, gender, and tooth type were controlled through stratification. Post-stratification analysis was conducted using the chi-square test, with a p-value of ≤ 0.05 considered statistically significant.

Ethical Approval: The study received ethical approval from the Institutional Ethical Review Committee of LUMHS. Written informed consent was obtained from all participants after explaining the study design, procedures, potential risks, and benefits. Patient confidentiality was maintained throughout the study, and all procedures adhered to the ethical principles outlined in the Declaration of Helsinki.

RESULTS

Out of 242 patients, Group A (Total Etch, n = 121) included 56 males (46.28%) and 65 females (53.72%), while Group B (Self Etch, n = 121) comprised 60 males (49.59%) and 61 females (50.41%), shown in table 1. The mean age was 34.46 ± 11.10 years in Group A and 36.84 ± 12.60 years in Group B. Regarding tooth type, Group A presented with 26 maxillary premolars (21.49%), 27 maxillary molars (22.31%), 38 mandibular premolars (31.40%), and 30 mandibular molars (24.79%), whereas Group B had 25 maxillary premolars (20.66%), 48 maxillary molars (39.67%), 26 mandibular premolars (21.49%), and 22 mandibular molars (18.18%). Overall, maxillary teeth were more frequent in Group B (73/121, 60.33%) compared to Group A (53/121, 43.80%).

Table 1: Baseline Characteristics of Study Population (n = 242)

Category	Variables	Group A (Total Etch, n;%)	Group B (Self-Etch, n;%)
Gender	Male	56 (46.28)	60 (49.59)
	Female	65 (53.72)	61 (50.41)
Age (years)	Mean ± SD	34.46 ± 11.10	36.84 ± 12.60
Tooth Type	Maxillary Premolar	26 (21.49)	25 (20.66)
	Maxillary Molar	27 (22.31)	48 (39.67)
	Mandibular Premolar	38 (31.40)	26 (21.49)
	Mandibular Molar	30 (24.79)	22 (18.18)
	Total Maxillary Teeth	53 (43.80)	73 (60.33)
	Total Mandibular Teeth	68 (56.20)	48 (39.67)

Table 2: Descriptive Statistics of Pre- and Post-Operative Sensitivity

Group	Stage	Total Patients	Minimum	Maximum	Mean	Std. Deviation
Group A (Total Etch)	Pre-Operative	121	1	3	1.75	0.699
Group B (Self Etch)	Pre-Operative	121	1	3	2.18	0.806
Group A (Total Etch)	Post-Operative	119	1	6	2.69	1.545
Group B (Self Etch)	Post-Operative	113	1	5	1.63	1.255

In Group A (Total Etch, n = 121), pre-operative sensitivity scores ranged 1–3 with a mean of 1.75 ± 0.699, while post-operative scores in 119 patients ranged 1–6 with a mean of 2.69 ± 1.545, shown in table 2. In Group B (Self Etch, n = 121), pre-operative scores ranged 1–3 with a mean of 2.18 ± 0.806, and post-operative scores in 113 patients ranged 1–5 with a mean of 1.63 ± 1.255. This reflects a relative increase in sensitivity after treatment in the total-etch group compared with a reduction in the self-etch group.

According to figure 1, among 242 patients, 198 (81.82%) completed follow-up at 4 weeks, 34 (14.71%) at 5 weeks, and 10 (4.13%) were lost to follow-up, resulting in a total retention rate of 95.90% (232/242 patients).

According to figure 2, at final follow-up (n = 232), 164 patients (70.69%) reported no post-operative sensitivity, while 68 patients (29.31%) experienced sensitivity.

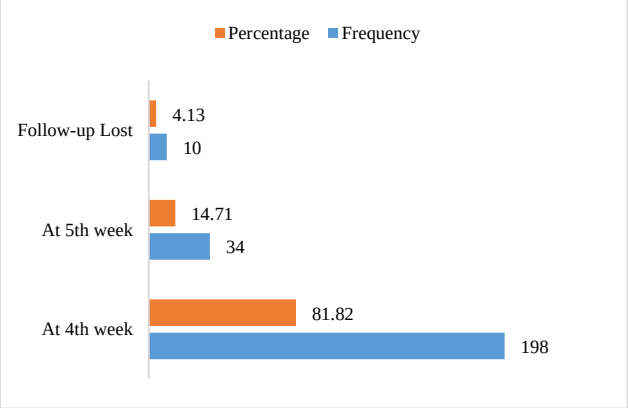

Figure 1: Follow-up Duration and Patient Retention at Final Evaluation

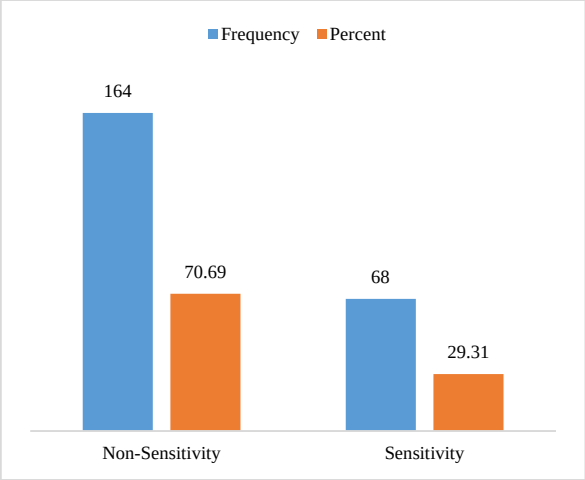

Figure 2: Sensitivity at Final Follow-up (n = 232)

In Group A (Total Etch, n = 119), 68 patients (57.14%) reported no sensitivity and 51 patients (42.86%) reported sensitivity (table 3). In Group B (Self Etch, n = 113), 96 patients (84.96%) were free of sensitivity while only 17 patients (15.04%) reported sensitivity. The difference between groups was statistically significant ($p < 0.00001$), favoring the self-etch adhesive.

At 1 week, cold sensitivity was the most frequent trigger, affecting 36 patients (70.50%) in Group A and 13 patients (76.40%) in Group B, while hot sensitivity occurred in 13 patients (25.40%) and 3 patients (17.60%), respectively, and bite sensitivity in 2 patients (3.90%) and 1 patient (5.80%), as shown in Table 4. At 2 weeks, cold sensitivity persisted in 32 patients (62.70%) in Group A and 10 patients (58.80%) in Group B; hot sensitivity was reported in 17 patients (33.30%) and 4 patients (23.50%); and bite sensitivity in 2 patients (3.90%) and 3 patients (17.60%), respectively. By the 4th week, cold sensitivity was observed in 29 patients (56.90%) in Group A and 8 patients (47.00%) in Group B; hot sensitivity in 18 patients (35.20%) and 4 patients (23.50%); and bite sensitivity in 4 patients (7.80%) and 5 patients (29.40%), respectively.

Table 3: Effectiveness of Treatment Groups (Chi-square Test)

Treatment Group	No-Sensitivity (n, %)	Sensitivity (n, %)	p-value
Group A (Total Etch Adhesive)	68 (57.14%)	51 (42.86%)	<0.00001
Group B (Self-Etch Adhesive)	96 (84.96%)	17 (15.04%)	

Table 4: Distribution of Sensitivity Triggers (Cold, Hot, Bite) at Different Follow-up Intervals (Chi-square Test)

Follow-up	Stimuli	Group A (n, %)	Group B (n, %)	p-value
1st Week (7 days)	Cold Test	36 (70.50%)	13 (76.40%)	0.7766
	Hot Test	13 (25.40%)	3 (17.60%)	
	Bite Test	2 (3.90%)	1 (5.80%)	
2nd Week	Cold Test	32 (62.70%)	10 (58.80%)	0.1576
	Hot Test	17 (33.30%)	4 (23.50%)	
	Bite Test	2 (3.90%)	3 (17.60%)	
4th Week	Cold Test	29 (56.90%)	8 (47.00%)	0.7236
	Hot Test	18 (35.20%)	4 (23.50%)	
	Bite Test	4 (7.80%)	5 (29.40%)	

Table 5: Intergroup Comparison of Sensitivity with Respect to Gender and Age Group (Chi-square Test)

Category	Subgroup	No-Sensitivity Cases	Sensitivity Cases	% Non-Sensitive	% Sensitive	p-value
Gender	Male	83	33	71.50%	28.40%	0.773
	Female	81	35	69.80%	30.20%	
Age Group (Years)	≤ 35 years	70	40	63.60%	36.40%	0.25
	36–65 years	94	28	77.00%	22.90%	

Table 6: Comparison of Post-Operative Sensitivity across Different Tooth Types (Chi-square Test)

Tooth Type	Non-Sensitive n (%)	Sensitive n (%)	p-value
Maxillary Premolar	48 (58.33%)	20 (41.67%)	0.735
Maxillary Molar	72 (80.47%)	14 (19.53%)	
Mandibular Premolar	62 (70.90%)	18 (29.10%)	
Mandibular Molar	50 (68.18%)	16 (32.82%)	

Among 116 males, 83 (71.50%) reported no sensitivity and 33 (28.40%) reported sensitivity, while among 116 females, 81 (69.80%) had no sensitivity and 35 (30.20%) had sensitivity ($p = 0.773$), shown in table 5. Age analysis showed that in patients ≤ 35 years (n = 110), 70 (63.60%) reported no sensitivity and 40 (36.40%) reported sensitivity, whereas in patients aged 36–65 years (n = 122), 94 (77.00%) reported no sensitivity and 28 (22.90%) had sensitivity ($p = 0.25$).

Among maxillary premolars (n = 68), 48 (58.33%) were non-sensitive and 20 (41.67%) were sensitive (table 6). In maxillary molars (n = 86), 72 (80.47%) were non-sensitive and 14 (19.53%) were sensitive. In mandibular premolars (n = 80), 62 (70.90%) showed no sensitivity and 18 (29.10%) had sensitivity, while among mandibular molars (n = 66), 50 (68.18%) were non-sensitive and 16 (32.82%) were sensitive. Differences across tooth types were statistically insignificant ($p = 0.735$).

DISCUSSION

In the present randomized controlled study, a total of 242 patients were evaluated to compare post-operative sensitivity following composite restorations using total-etch and self-etch adhesive systems. At final follow-up, 29.31% of patients reported sensitivity, whereas 70.69% were free of symptoms. When analyzed by treatment group, significantly fewer patients in the self-etch group reported post-operative sensitivity (15.04%) compared to the total-etch group (42.86%), with a highly significant p-value (<0.00001). These findings suggest that self-etch adhesives may provide superior outcomes in terms of patient comfort. Similar observations were reported by previous study, who demonstrated reduced incidence of sensitivity with self-etch systems compared to conventional total-etch techniques [13,14].

Pre- and post-operative Visual Analogue Scale (VAS) scores further supported these findings. In the total-etch group, sensitivity increased from a mean of 1.75 ± 0.70 pre-operatively to 2.69 ± 1.55 post-operatively. Conversely, in the self-etch group, sensitivity decreased from 2.18 ± 0.81 pre-operatively to 1.63 ± 1.26 after treatment. This divergence highlights the potential of self-etch systems to not only limit the increase in post-operative sensitivity but also to reduce pre-existing discomfort. Similar reductions in sensitivity with self-etch adhesives have been documented by

previous study, who attributed the outcome to the ability of mild self-etch primers to prevent over-etching of dentin and maintain residual hydroxyapatite for chemical bonding [15].

Follow-up analysis revealed that sensitivity was most frequently triggered by cold stimuli, affecting 70.50% of total-etch patients and 76.40% of self-etch patients at one week. Although cold sensitivity decreased over time in both groups, it remained more prevalent in the total-etch group at four weeks (56.90% vs. 47.06%). This pattern aligns with previous findings, who emphasized that incomplete sealing of dentinal tubules following phosphoric acid etching may allow fluid shifts that intensify thermal sensitivity [16].

When patient demographics were considered, no statistically significant association was found between gender and post-operative sensitivity (male: 28.45%, female: 30.17%, $p = 0.773$). Age stratification suggested that patients ≤ 35 years were more prone to sensitivity (36.36%) compared to those aged 36–65 years (22.95%), although this trend was not statistically significant ($p = 0.25$). These results parallel previous studies indicating that younger patients often exhibit wider dentinal tubules and higher pulpal responsiveness, potentially increasing sensitivity risk [17].

Tooth type analysis also showed no significant association ($p = 0.735$). Maxillary molars demonstrated the lowest sensitivity rate (19.53%), while maxillary premolars exhibited the highest (41.67%). Similar distributions were reported by previous study, who suggested that anatomical variations, dentin thickness, and occlusal loading differences may contribute to sensitivity patterns across tooth groups [18].

Strengths and Limitations: The major strength of this study lies in its randomized controlled design with adequate sample size ($n = 242$), standardized clinical procedures, and the use of validated outcome measures such as the Visual Analogue Scale (VAS) and clinical sensitivity tests, which enhance both internal and external validity. Furthermore, stratification for potential confounders, including age, gender, and tooth type, minimized bias. However, the study had certain limitations. The follow-up period was relatively short (four weeks), which restricted evaluation of long-term post-operative sensitivity. Additionally, being a single-center study limited the generalizability of results to wider populations, and operator-related variability, though minimized, cannot be completely excluded.

CONCLUSION

This study demonstrated that self-etch adhesive systems significantly reduced post-operative sensitivity compared to total-etch systems, with only 15.0% of patients in the self-etch group experiencing sensitivity versus 42.9% in the total-etch group ($p < 0.00001$). While total-etch procedures showed an increase in mean sensitivity scores post-operatively (1.75 ± 0.699 to 2.69 ± 1.545), self-etch adhesives resulted in a decrease (2.18 ± 0.806 to 1.63 ± 1.255). These findings indicate that self-etch adhesives offer superior patient comfort without compromising clinical outcomes, thereby supporting their wider use in restorative dentistry for minimizing post-operative complications.

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