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Original Article

Dentistry Section

Post-operative Sensitivity of Selective-etch and Total-etch Techniques in Composite Resin Restorations: An In-vivo Study

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ABSTRACT

Introduction: Composite restorations placed using selective-etch technique has been claimed to induce significantly lower postoperative sensitivity than a three-step etch and rinse technique. Selective-etch technique overcomes the main drawback of self-etch technique, which is suboptimal etching of mineralised enamel, by acid etching only the enamel prior to using the adhesive. The newer universal bonding agent can be used in a self-etch, selective-etch, or etch and rinse mode.

Aim: To evaluate the influence of selective-etch versus total-etch techniques of using Scotchbond universal adhesive on the postoperative sensitivity in composite restorations placed by undergraduate students.

Materials and Methods: Sixty patients with ICDAS code 4 or 5 cavities for composite restorations by undergraduate students were randomly allocated into two groups. Restorations were done using Filtek Z350 XT and Scotchbond™ Universal Adhesive. In total-etch group, the entire preparation was acid etched for 20 seconds, and rinsed with water spray for 15 seconds. In selective-etch group, only the enamel was acid etched for 20 seconds, and rinsed. The postoperative sensitivity of the restorations was evaluated preoperatively, immediately after treatment, 24 hours and 2 weeks after treatment. Sensitivity scores were generated from the patient's response to a Visual Analogue Scale (VAS) having scores from 0 to 10. The results were statistically analysed using Mann Whitney U-test and Friedman test. The level of significance was set at p-value less than 0.05.

Results: There was no significant difference in the sensitivity between total-etch and selective-etch groups pre-treatment and during three postoperative follow-up periods (p-value >0.05). However, there was statistically significant decrease in the sensitivity at 24 hours and 2 weeks after treatment when compared with baseline scores in both total-etch and selective-etch groups (p-value <0.001).

Conclusion: Both total-etch and selective-etch techniques of bonding using universal adhesive systems can be safely practiced by dental undergraduate students without the fear of developing postoperative sensitivity in patients.

Keywords: Acid etching, Composite bonding, Dentin sensitivity, Universal adhesive system, Visual analogue scale

INTRODUCTION

Advances in dentin bonding systems have minimised the incidence of post-operative sensitivity after composite resin restorations. Newer self-etch systems simultaneously, etch, infiltrate, and polymerise to seal the prepared dentin [1]. This allows complete hybridisation of demineralised dentin by adhesive monomers and reducing post-operative sensitivity [1,2]. Selective-etch technique overcomes the main drawback of self-etch technique, which is sub-optimal etching of mineralised enamel, by acid etching only the enamel prior to using the adhesive [3].

The main drawbacks associated with etch and rinse systems are, potential contamination while washing the acid etchant, longer etching times, and over drying the dentin [2]. With the known benefits of self-etch bonding agent, there is a general trend to replace etch and rinse systems with the newer self-etch bonding agents [4]. However, it is difficult to precisely etch only the enamel without having the acid to smear over the dentin. Moreover, the inherently acidic self-etch systems have more water in their composition making them susceptible to hydrolysis and disintegration over time [5,6]. Universal bonding agents were introduced to overcome the drawbacks of self-etch systems and have been used in clinical practice since 2011. These "multi-mode" adhesives can be used in a self-etch, etch and rinse, or selective-etch technique [7,8].

A less complicated technique and material would be preferred in student teaching where less experienced students are involved [9]. Students in Malaysian dental schools, are exposed to selective-etch and total-etch techniques while using universal bonding systems. The purpose of this study was to determine the effect of selective-etch and total-etch techniques on the post-operative sensitivity after placing composite restorations using a universal bonding agent.

MATERIALS AND METHODS

This in-vivo study was conducted in the Department of Conservative Dentistry at Melaka Manipal Medical College from November-December 2018 and was approved by the Research Ethics Committee, Faculty of Dentistry, Melaka-Manipal Medical College (Ethical approval no. MMMC/FOD/AR/B6/E C-2018;24). The restorations were performed by 12 undergraduate students posted in the Department of Conservative Dentistry and the post-operative sensitivity after treatment was evaluated by a single evaluator. All the students received extensive clinical training and demonstration by the supervisor, so as to standardise the protocol for the treatments performed. The sample size was calculated according to the previous study by portigao J et al., in which total of 66 patients were selected [10].

Patients from the Out-Patient Department (OPD), allocated for restorative treatment by undergraduate students of the dental school, was the source population. Sixty patients over the age of twenty years of either gender, presenting with International Caries Detection and Assessment System (ICDAS) code 4 or 5 cavities [11] on a periodontally sound and asymptomatic vital tooth were allocated into two groups using a random number table. Tooth vitality was assessed by electric and thermal pulp sensitivity tests. Periodontal charting was done and teeth with probing depths beyond 4 mm were excluded

from the study. Patients with poor oral hygiene, generalised sensitivity, and known para-functional habits were excluded. Patients undergoing orthodontic treatment, patients who have got periodontal surgery done in the last three months, teeth not in normal occlusion, were also excluded. The nature of the study was explained to the patients and a written informed consent was obtained.

Clinical Procedure

Preoperative sensitivity was recorded for all cases using a VAS. Tooth preparation was done using ISO #15 round diamond bur (Shofu Inc, Kyoto, Japan), in a high-speed hand piece under water coolant. Restorations were done using Filtek Z350 XT (3M ESPE Dental Products, St Paul, MN, USA) and Scotchbond™ Universal Adhesive (3M ESPE, St. Paul, MN, USA). Acid etching was done with a 35% phosphoric acid etchant (Ultra-EtchTM, Ultradent Products, Inc). All materials were handled based on manufacturer's instructions.

Group 1- Total-etch Technique

The entire preparation was acid etched for 20 seconds and rinsed with water spray for 15 seconds. Dentin was blot dried using absorbent papers, while the peripheral enamel was air dried until frosty white. The universal adhesive was applied throughout the preparation using a micro-applicator (Micro Applicators, Ultradent Products, Inc) for 20 seconds and gently air dried. After light curing the adhesive for 20 seconds, composite resin was placed in 2 mm increments in an oblique incremental technique. Each increment was light cured for 30 seconds.

Group 2- Selective-etch Technique

Only the enamel was acid etched for 20 seconds and rinsed with water spray for 15 seconds. After air drying for 15 seconds, the same procedure was performed as above in the total-etch technique.

The restorations were evaluated preoperatively, immediately after treatment, 24 hours after treatment and 2 weeks post-operatively, for sensitivity to compressed air and on chewing food. Sensitivity scores were generated from the patient's response to a VAS having scores from 0 to 10, denoting no sensitivity to intolerable sensitivity. Compressed air was applied from the three-way dental unit syringe at a distance approximating 2 cm.

STATISTICAL ANALYSIS

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS, software version 17.0, IBM, Chicago, IL, USA). The level of significance was set at p-value less than 0.05. The median values of the post-operative sensitivity intra-group between the three follow-ups and inter-group between the corresponding follow-up periods were analysed using Friedman test and Mann-Whitney U test, respectively.

RESULTS

The mean and SD of patients age in total-etch was 39.73 (12.46) and in selective-etch was 38.0 (14.18). There were no significant differences in the baseline characteristics between total-etch and selective-etch groups [Table/Fig-1].

Variable	Total-etch (N=30) Frequency (%)	Selective-etch (N=30) Frequency (%)	p-value
Age[a]			
Mean (SD)	39.73 (12.46)	38.00 (14.18)	0.617
Gender[a]			
Male	14 (46.7)	17 (56.7)	0.438
Female	16 (53.3)	13 (43.3)	
Baseline sensitivity (VAS)[a]			
Median (Q1, Q3)	1.0 (0.0, 3.0)	1.0 (0.0, 3.0)	0.448

[Table/Fig-1]: Baseline characteristics between Total-etch and Selective-etch groups.
[a]Mann-Whitney U test; N: Number of samples

Immediately after treatment, median sensitivity score of total-etch was 0.0 and selective-etch was 1.0; however, it was not significant (p-value 0.854). Similarly, there was also no significant difference of sensitivity between total-etch and selective-etch at 2 weeks after treatment as both groups had median 0.0 (Q1=0.0, Q3=0.0) (p-value 0.949) [Table/Fig-2].

Variable	Total-etch (N=30) Median (Q1, Q3)	Selective-etch (N=30) Median (Q1, Q3)	p-value
Immediately after treatment[b]	0.0 (0.0, 1.0)	1.0 (0.0, 3.0)	0.854
24 hours after treatment[b]	0.0 (0.0, 1.0)	0.0 (0.0, 1.0)	0.596
2 weeks after treatment[b]	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.949

[Table/Fig-2]: Comparison of post-operative sensitivity, VAS scores between Total-etch and Selective-etch groups immediately after the treatment, 24 hours and 2 weeks after treatment.
[b]Mann-Whitney U test; N: Number of samples

At baseline, the median sensitivity of total-etch was 1.0 (Q1=0.0, Q3=3.0) which was significantly decreased to median of 0.0 immediately after treatment, 24 hours and 2 weeks after treatment (p-value <0.001). Among selective-etch group, the median sensitivity was 1.0 at baseline and immediately after treatment but it was significantly decreased to median sensitivity of 0.0 at 24 hours and 2 weeks after treatment (p-value <0.001) [Table/Fig-3]. The mean values (SD) of post-operative sensitivity in total-etch group was 0.63 (0.96), 0.50 (0.77), 0.23 (0.50) immediately after treatment, 24 hours and 2 weeks after treatment, respectively. In selective-etch group, it was 0.53 (0.63), 0.33 (0.48), 0.20 (0.41) immediately after treatment, 24 hours and 2 weeks after treatment, respectively.

Variable	Baseline median (Q1, Q3)	Immediate after treatment median (Q1, Q3)	24 hours after treatment median (Q1, Q3)	2 weeks after treatment median (Q1, Q3)	p-value
Total-etch[c]	1.0 (0.0, 3.0)	0.0 (0.0, 1.0)	0.0 (0.0, 1.0)	0.0 (0.0, 0.0)	<0.001
Selective-etch[c]	1.0 (0.0, 3.0)	1.0 (0.0, 3.0)	0.0 (0.0, 1.0)	0.0 (0.0, 0.0)	<0.001

[Table/Fig-3]: Comparison of Post-operative sensitivity, VAS scores between the three follow-ups: immediately after treatment, 24 hours and 2 weeks after treatment in Total-etch and Selective-etch groups.
[c]Friedman test

DISCUSSION

The results of this study indicate that both the techniques have no significant difference in post-operative sensitivity when Scotchbond universal bonding agent was used.

Rosa WL et al., in their systematic review and meta analysis stated that selective-etching of the enamel prior to application of a mild universal adhesive is an advisable strategy to optimise bond strengths [12]. Perdigao J and Swift EJ Jr., reported inferior clinical performance of composite restorations placed using a self-etch technique with universal bonding agents [4]. Taking this into consideration, in the present study, a selective-etch technique was chosen over a self-etch strategy. Separate etching of dentin with phosphoric acid has been stated to cause inferior hybridisation with the use of self-etch bonding agents [13]. This detrimental effect of acid etching the dentin while using the self-etch agents does not seem to be present while using Scotchbond Universal. Previous self-etch adhesives were hydrophilic in nature leading to hydrolytic disintegration of the adhesive layer by the dentinal fluid [14]. The 10-Methacryloyloxydecyl Dihydrogen Phosphate (MDP) molecule in Scotchbond Universal renders the system more hydrophobic than previous self-etch systems [15].

Operator efficiency has been stated as a major influencing factor on the clinical outcome, when multi-step total-etch technique is used [16]. Although the present study was conducted by novice operators, it did not show any significant difference in post-operative sensitivity with total-etch technique or selective-etch technique. Advances in adhesive technology would have rendered Scotchbond

Universal less technique sensitive leading to reduced post-operative sensitivity. All restorations placed by the undergraduate students were closely monitored by the supervisor and were performed strictly adhering to the protocols of adhesive dentistry. This could have had a positive outcome on the overall quality of restorations leading to less post-operative sensitivity. Universal adhesives could replace previous self-etch systems since they can be used in both selective-etch and total-etch techniques. A meta analysis reported that the micro-tensile bond strengths with the use of a universal adhesive (Scotchbond Universal, 3M ESPE) in etch-and-rinse and self-etch modes were not significantly different [17]. Also, separate etching of the dentin prior to application of universal adhesive did not affect its bond strength [18].

This study showed that there was no significant difference in sensitivity between total-etch and selective-etch techniques at baseline, immediately after treatment, 24 hours and 2 weeks after treatment. The results of this study are in accordance with similar in-vivo studies [10,19,20]. A study by Perdigao J et al., in which 30 restorations were placed using self-etch and 36 restorations with total-etch, found no statistically significant difference in post-operative sensitivity between self-etch and total-etch materials [10]. Browning WD et al., evaluated post-operative sensitivity 13 weeks after treatment and found no significant difference between total-etch and self-etch technique [19]. A study evaluated the influence of a three-step total-etch versus two-step self-etch adhesive system on immediate post-operative sensitivity and found no statistically significant difference between the two groups [20]. On the contrary, a study done by Opdam NJ et al., showed that the post-operative sensitivity was less with a self-etch technique as compared to a total-etch technique [21]. This could be due to older bonding systems that were used in their study. Kaczor K et al., in their systematic review and meta analysis stated that separate etching of the dentin with phosphoric acid did not increase nano-leakage with the use of Scotchbond Universal adhesive as compared to its use in a self-etch mode [22]. Micro/nano-leakage have been stated as the major causes for post-operative sensitivity with adhesive resin restorations [23]. This study shows that dental students can practice both total-etch and selective-etch techniques of bonding composites, while using Scotchbond Universal bonding agent without the fear of developing post-operative sensitivity.

Limitation(s)

A relatively small sample size, and the comparatively short time duration of follow-up periods. Also, individual differences in sensory experiences of pain can lead to subjective variations in reporting post-operative sensitivity [24].

CONCLUSION(S)

It could be concluded that there is no significant difference in post-operative sensitivity between total-etch and selective-etch groups during the three post-operative follow-up periods. It is suggested that the dental students should have clear understanding of the basic principles and have adequate training for proper clinical application of adhesive systems. Following a standardised protocol and handling the materials based on manufacturer's instructions can significantly help to minimise post-operative sensitivity in composite restorations. Further studies should be conducted with larger sample size and long-term follow-up to evaluate the post-operative sensitivity with both these techniques.

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