Gingival microleakage of composite restorations with different bonding protocol in class II cavity treated with chlorhexidine (an in-vitro study).

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ABSTRACT

Background: One of the challenges to use chlorhexidine is its effect on the amount of microleakage after restoration; however, use of the materials with antibacterial properties after tooth preparation and before restoration has been widespread. The objective of this, in-vitro, study was to evaluate the influence of consepsis (chlorhexidine gloconate disinfectant) application on microleakage in class II cavities restored with light cured composite using universal adhesive system; etch and rinse technique –self etch technique.

Materials and Methods: Forty class II cavities were prepared on mesial and distal surfaces of 20 non-carious mandibular third molars. The cavities were divided into four groups; (n =10 for each group). G1: cavities were bonded with (single bond universal adhesive, 3MESPE) after etching with 35% phosphoric acid - etch and rinse technique, without chlorhexidine , G2: chlorhexidine was used after etching with 35% phosphoric acid, then cavities were bonded with (single bond universal adhesive, 3MESPE) - etch and rinse technique . G3: cavities were bonded with (single bond universal adhesive, 3MESPE) - self etch technique, without chlorhexidine, G4: The chlorhexidine was used before bonding. All groups were restored with non – hybrid composite resin (Z 350, 3MESPE). Micrlerackage was evaluated at gingival margin using methylene blue dye penetration method. In each cavity the dye penetration in millimeters was measured by strereomicroscope. Statistical analysis for the data was carried out using one-way ANOVA and LSD test.

Results: Group G2 produced the least microleakage which is statistically highly significantly different than the remaining groups. Group G3 produced the highest microleakage which is statistically high significant difference than G1 and G2, but the difference is not significant with group G4.

Conclusions: Consepsis can be used as cavity disinfectants when restoring the cavities with single bond universal adhesive as etch and rinse technique. However, its effect seems to be lower when using the single bond universal adhesive as self-etch technique.

Keywords: chlorhexidine, microleackage, universal adhesive. **(J Bagh Coll Dentistry 2017; 29(1):16-19)**

INTRODUCTION

The most significant problem associated with the composite restorations is the polymerization shrinkage, as it has the potential to initiate gap formation at the tooth-composite interface, which can lead to microleakage, secondary caries, and eventually leading to failure of the bond. Micro leakage remains a problem of clinical significance, although various generations of dentin bonding agents have been developed to reduce the effects of polymerization shrinkage [1]. Incomplete sterilization of the preparation as a consequence of failure to mechanically remove infected tooth structure can be magnified the problems associated with microleakage. A number of studies have demonstrated that the bacteria left in the dentin of a cavity preparation could maintain their activity for a long time, only a small proportion of the teeth are sterile after cavity preparation as have shown by Histological and bacteriologic studies [2]. The use of a disinfectant solution has been suggested to solve this issue. Previous studies have depicted that a number of antibacterial solutions such as chlorhexidine, sodium hypochlorite, fluoride based solutions and bensalkonum chloride, can be used as cavity disinfectants to eliminate residual bacteria from prepared cavities.

Some of the disinfectant solutions were found not to affect either the bond strength or the sealing ability of dentin bonding agents. However, depending on the brand of materials and application methods, some of the solutions have shown an adverse effect on the issues mentioned [3]. The aim of this study was to evaluate the influence of consepsis (chlorhexidine gloconate disinfectant) application on microleakage of compsite returations in class II cavities restored with light cured composite using universal adhesive system.

MATERIALS AND METHOD

A total 20 freshly extracted caries free, human permanent mandibular third molars were selected for this study. Immediately after extraction, the teeth were cleaned of debris with scaler, then pumiced with a rubber prophylaxis cup and pumice for 30 seconds after that, the teeth were stored in normal saline for maximum period of one month (at 40^0C until use) [1, 2]. The criteria for tooth selection included (1) an intact crown enamel and (2) lack of caries or cracks [4]. Proximal boxes of standard dimensions were

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prepared on both proximal surfaces in all twenty teeth resulting in forty cavities Figure 1.

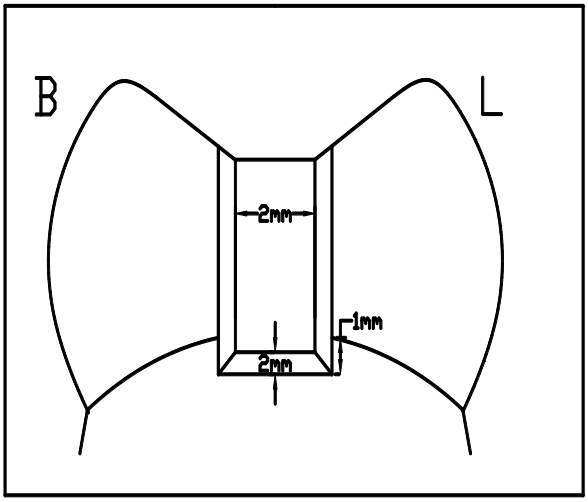

Figure 1: a diagram showing the dimensions of cavity design used in this study.

Cavity preparation was made by using diamond round bur (REF S6801, Komet, Germany) and a parallel sided flat-ended diamond fissure bur (REF S6835, Komet, Germany), both with a high speed and water cooled hand piece (NSK). The occlusal portion of the preparation had a facio-lingual width of 2 mm. the gingival floor of the proximal box was kept 1mm below the cemento-enamel junction to keep the gingival margins in dentin [1]. Each preparation was rinsed for 20 seconds with distilled water and dried with blast of compressed air for 5 seconds. Caution was taken not to over dry the preparation. The samples were randomly distributed in to four experimental groups, each consisting of 10 cavities. All the cavities were restored as given below: Group 1(G1): The cavity surfaces were treated with 35% phosphoric acid for 15 seconds, washed and blot dried. Then, the bonding agent (single bond universal adhesive,3M ESPE) was applied according to manufacturer's Instruction with saturated micro brush, rubbed on surface for 15 seconds and light cured for 20 seconds by Vivadent light cure unit. The cavities were restored according to layering technique with nanohybrid composite (Z350, 3M ESEP) and each increment was light cured for 20 seconds. Group 2 (G2): The cavity surfaces were treated with 35% phosphoric acid, washed and blot dried. 2% chlorhexidine cavity disinfectant (consepsis, Ultradent) was applied with a sterile brush applicator. Consepsis solutions consist of chlorhexidine gluconate and ethyl alcohol with a ph of 6.0. The disinfectant was left in contact with cavity walls for 20 seconds followed by blast of compressed air for 5 seconds [1].The bonding and restoration procedure was performed similar to G1. Group 3 (G3): single bond universal adhesive was applied according to manufacturer's instruction with saturated micro brush, rubbed for 15 seconds and light cured for 20 seconds. The cavities were restored as in groups G1 and G2. Group 4 (G4): A 2% chlorhexidine cavity disinfectant (consepsis, ultradent) was applied as group G2, single bond universal adhesive was applied according to manufacturer's instructions with a saturated micro brush, rubbed for 15 seconds and light cured for 20 seconds. The cavities were restored with composite as other groups of this study (Table.1).

Table 1: Groups of this study.

Groups	Acid Etching	Disinfectant	Dentin bonding agent
G1	Total-etch	No	Single bond universal adhesive
G2	Total-etch	Consepsis	Single bond universal adhesive
G3	Self-etch	No	Single bond universal adhesive
G4	Self-etch	Consepsis	Single bond universal adhesive

All teeth were stored in distilled water at 37 ^{0}C for 24 hours in incubator and then subjected for thermal cycling with 500 cycles between water baths of 5^{0}C and 55^{0}C with a dwell time of 15second [5, 6]. The teeth were covered with two coats of nail varnish to within approximately 1mm away from the margins of proximal box, after the root apices were sealed with molding wax. The specimens were immersed in methylene blue dye in separated sealable vials at 37^{0}C for 24 hours. After staining the teeth were rinsed off to remove residual dye. The radicular parts of the teeth were cut 6mm below the cemento-enamel junction. Coronal parts were sectioned mesiodistally in the approximate center of the restorations with a diamond disk in a straight air motor hand piece. The dye penetration of the gingival margins of each section was evaluated independently by two observers using a stereomicroscope type (Hamilton, Biovision 320) at a magnification of X40 and dye penetration was recorded in millimeters[7]. Then the data was analyzed using one way ANOVA and LSD test.

RESULTS

The results of this study were collected and analyzed statistically. The Mean, Standard Deviations, Standard Error, Minimum and Maximum of the experimental groups are shown in **Table 2**.

Table 2: Descriptive Statistics of all groups.

Groups	N	Means	±SD	Min	Max
G1	10	1.15	0.80	0.0	1.8
G2	10	0.29	0.32	0.0	0.8
G3	10	2.05	0.10	1.9	2.2
G4	10	1.97	0.08	1.8	2.1

Under the experimental conditions of this study, group2 (Total-etch with Chlorhexidine) has the lowest mean value of microleakage while G3 (Self-etch without chlorhexidine) has the highest mean value of microleakage Figure 2.

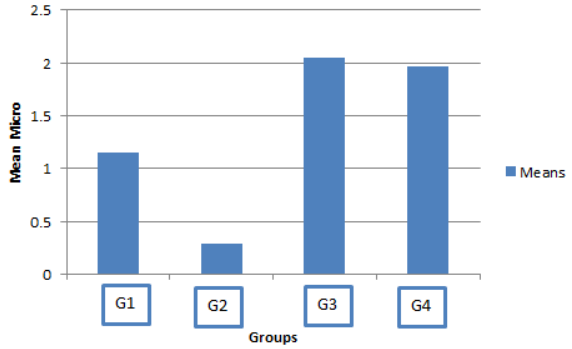

Figure 2: The mean of microleakage of groups of this study.

Analysis of Variance (ANOVA) test showed that there were highly significant differences between the tested groups of this study Table 3.

Table 3: One-Way Analysis of Variance

	Sum of squares	df	Mean squares	F	P-value
Between groups	20.371	3	6.790	35.634	0.000*
Within groups	6.860	36	0.191		
Total	27.231	39			

*HS: High- significant

LSD test was performed regarding the sealing ability of the tested groups, Table 4. LSD test showed that the group G1 has statistically high significant difference more microleakage, as compared with group G2 while the group G1 has statistically high significant difference less microleakage, as compared with group G3 and G4. Also the results showed that the group G2 has statistically high significant difference less microleakage, as compared with group G3 and G4.While the group G3 has statistically non-significant difference as compared with group G4.

Table 4: LSD test of groups of this study.

I(Groups)	J(Groups)	Mean difference	P-value
G1	G2	0.86	0.000*
	G3	-0.90	0.000
	G4	-0.82	0.000
G2	G3	-1.80	0.000
	G4	-1.70	0.000
G3	G4	0.08	0.684**

*HS: High- significant
**NS: non- significant

DISCUSSION

One of the main factors stimulating the sensitivity of the pulp is infection caused by bacteria attack, whether existing in smear layer or emerges as the result of microleakage after restoration[8]. Brannstorm et al in 1972[9] suggested that, dentin should be sterilized before placement of any restorative material, because his study reported the prevalence of high frequency of bacteria beneath the composite restorations. Many chemicals had been proposed for this purpose. Recently, it is known that these chemical are irritating to the pulp when applied to the dentin surface [2].In this study, concepsis was used as a cavity disinfectant because in other studies chlorhexidine cavity disinfectant solutions displayed the most effective and the longest antibacterial activity, which will contribute to elimination of residual bacteria[3].Single bond universal adhesive chosen in this study because it can be used as a total-etch adhesive system or self-etching adhesive. It was chosen to examine how chlorhexidine would affect two different smear layer management techniques in different sequences of bonding according to their clinical use. According to the results of this study, using chlorhexidine before bonding and after etching significantly decreased the microleakage when used single bond adhesive system as total etch-technique. Total-etch adhesive system operates by removing the smear layer and subjacent dentin, so, it is more reasonable to disinfect the dentin after etching [10]. Therefore, it is better not to rinse off the consepsis if it would not have an adverse effect on the bonding process [1, 3]. Some clinicians prefer to apply the disinfectant before acid etching, but the application sequence of the disinfectant depends on the generation of the bonding system [3].Only a few researches have revealed an increased amount of microleakage when not rinsing chlorhexidine before dentin

bonding agent application[3,11]. Gjermo in 1989[12] stated that chlorhexidine has a strong positive ionic charge making capable of easily binding to phosphate groups. It has strong affinity for tooth surface and this affinity is increased by acid-etching. Chlorhexidine also increases the surface free energy of enamel and can as well have a similar effect on dentin, so chlorhexidine could improve the sealing ability of the adhesives [13]. So the results of this study was agree with results of Agrawal et al 2013[1] and Shafiei et al 2010[14] regarding the total-etch technique. On the other hand the results of this study regarding the self-etch technique would reveal decrease the microleakage when using chlorhexidine but not significantly different, the results of this study was agree with results of Alikhani and Heidari in 2015[8]. Self-etch dentin bonding systems affect the smear layer using a milder acidic monomeric primer with no rinse step necessitating the smear layer to be disinfected before using acidic primer [10]. According to Meirs and Kresin 1996 [15]chlorhexidine washes did not remove the smear layer but did modify its appearance by removing loose smear debris. Gultz et al in 1999 [16] found that chlorhexidine demineralize the dentin and envelop the collagen fibers and hydroxylapatite crystals. The scanning electron microscopic observations of their study revealed the presence of resin-tags in the consepsis treated group and the same finding would obtain by Pattanaik and Chandak in 2013[2]. However, the results of this study are conflicting with other studies, as chlorhexidine had an adverse effect on Syntac and prime[17], Adeper easy one self -etch adhesive[1] and produced significantly higher microleakage when used with these bonding systems. Pattanaik and Chandak in 2013[2] concluded that the use of cavity disinfectant with resin composite restorations appears to be material specific, with regard to interaction with the ability of various dentin bonding systems to seal dentin.

- Within the limitations of this in-vitro study, it can be concluded that the use of consepsis as a cavity disinfectant has a definite beneficial role when used single bond adhesive system as etch and rinse technique rather than self- etch technique.
- The results indicated that consepsis solution may not interfere with sealing ability of tested techniques.

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