Original article:

Effect of cavity disinfection with chlorhexidine on microleakage of composite restorations using total etch and self etch single bottle adhesive systems: an in-vitro study

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ABSTRACT:

Introduction: The aim of our study was to evaluate the effect of chlorhexidine cavity disinfectant on microleakage in Class II cavities restored with light cured composites using two adhesive systems.

Materials and Method: Class II cavities were prepared on mesial and distal surfaces of 40 non-carious mandibular first molars, resulting in total 80 cavities. All 80 cavities were rinsed with 2% chlorhexidine (Consepsis, Ultradent) cavity disinfectant. 40 cavities were restored with total etch adhesive system (Adper single bond plus, 3M ESPE) and nanohybrid composite resin (Z350, 3M ESPE) while other 40 cavities were restored with self etch single bottle adhesive system (Adper easy one self etch, 3M ESPE) and nanohybrid composite resin. Microleakage was evaluated at the gingival margin using methylene blue dye penetration method.

Results & Conclusion: Rinsing off the cavity disinfectant before the bonding procedure does not effect the seal at the resin-tooth interface. When using either of the adhesive systems, however, chlorhexidine cavity disinfectant produced significantly higher microleakage while restoring the cavities using a self etch single bottle adhesive system.

Keywords: chlorhexidine, microleakage, self etch, total etch

INTRODUCTION

Polymerization shrinkage appears to be the most significant problem with the composite restorations, 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. Although various generations of dentin bonding agents have been developed to reduce the effects of polymerization shrinkage, microleakage remains a problem of clinical significance. Residual bacteria have been shown to proliferate from the smear layer even in the presence of a good seal from the oral cavity. Other studies have shown that bacteria left in the prepared cavity could survive for a long time and this problem may be magnified by microleakage of composite resin at margins not ending on enamel. Based upon these evidences, the use of antibacterial cavity cleanser has been recommended after cavity preparation to eliminate the potential risks due to bacterial activity. Chlorhexidine has been recommended by various authors as an effective agent to disinfect dentin. It is also effective in reducing the levels of S. mutans found on exposed carious root.
surfaces. The purpose of this study was to evaluate the effect of 2% chlorhexidine cavity disinfectant on microleakage at the gingival margins in cavities restored with total etch and self etch single bottle adhesive systems.

**MATERIALS AND METHOD**

The study was carried out at Department of Conservative Dentistry & Endodontia, Karnavati School of Dentistry, Uvarsad, Gandhinagar. Forty freshly extracted caries free, human permanent mandibular first molars were used. Teeth were cleaned of debris and were stored in normal saline for a maximum period of one month. Proximal box-only cavities of standard dimensions were prepared on both proximal surfaces in all forty samples resulting in eighty cavities. The occlusal portion of the preparation had a facio-lingual width of 1.5mm. The gingival floor of the proximal box was kept 0.8-1.0mm below the cemento-enamel junction to keep the gingival margins in dentin. Each preparation was rinsed for 20secs with distilled water and dried with a blast of compressed air for 5secs. Caution was taken not to overdry the preparation. The samples were distributed into two experimental groups, each consisting of 40 cavities each. All the cavities were restored as given below:

**Group 1**

- The cavity surfaces were treated with 35% phosphoric acid, washed and blot dried. A 2% chlorhexidine cavity disinfectant (Consepsis, Ultradent) was applied with a sterile brush applicator. Consepsis solution consists of chlorhexidine gluconate and ethyl alcohol with a pH of 6.0. The disinfectant stayed in contact with each tooth for 20secs followed by blast of compressed air for 5secs. Total etch adhesive system (Adper single bond plus, 3M ESPE) was applied and rubbed on surface for 15secs and light cured for 20secs by Vivadent light cure unit. The cavities were filled with two increments of nanohybrid composite resin (Z350, 3M ESPE) and light cured for 40secs.

**Group 2**

- A 2% chlorhexidine cavity disinfectant was applied as in group 1, self etch single bottle adhesive system (Adper easy one self etch, 3M ESPE) was applied according to manufacturer’s instruction with a saturated micro brush, rubbed for 15secs and light cured for 20secs. The cavities were restored as in group 1.

All teeth were stored in distilled water at 37 °C for 24 hours. The teeth were covered with two coats of nail varnish to within approximately 1.0mm of gingival margin, after the root apices were sealed with modeling wax. The specimens were immersed in methylene blue dye in separate sealable vials at 37 °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 handpiece. Microleakage was assessed for gingival margins at X30 magnification by two examiners according to the following scale:

0- No dye penetration
1- Upto 1/3rd of length of gingival margin
2- Upto 2/3rd of length of gingival margin
3- Covering full length of gingival margin

A nonparametric analysis of variance was used to determine whether there were significant differences among groups. Since the values for microleakage were described as categorical variables, group wise comparisons were made using categorical two way tables using proportions.
DATA AND RESULTS
Since the data had categorical variables, the groups were compared using the proportions of samples with a particular score in each group. Two way tables of proportions were calculated and used for statistical evaluation using Kruskal-Wallis test (Table I). In 65% of cavities, which were restored using chlorhexidine disinfectant & total etch adhesive system there was no microleakage, but the number decreased to 35% with the use of self etch single bottle adhesive system (p<0.05) (Fig.1)

<table>
<thead>
<tr>
<th>Microleakage scores</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>26(65)</td>
<td>14(35)</td>
</tr>
<tr>
<td>1</td>
<td>8(20)</td>
<td>8(20)</td>
</tr>
<tr>
<td>2</td>
<td>4(10)</td>
<td>12(30)</td>
</tr>
<tr>
<td>3</td>
<td>2(5)</td>
<td>6(15)</td>
</tr>
</tbody>
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(Fig.1 : A X30 magnification showing dye penetration covering the full length of gingival floor in self etch single bottle adhesive system group and upto 1/3rd in total etch adhesive system group)

Table 1: Categorical two way proportions of samples showing microleakage in both the groups

(0-No dye penetration, 1- Upto 1/3rd of length of gingival margin, 2- Upto 2/3rd of length of gingival margin, 3-Covering full length of gingival margin, figures given in parenthesis are in percentage)

DISCUSSION
A major cause of secondary caries is the presence of bacteria in the smear layer, after cavity preparation, which can remain viable for long periods of time. An alternative approach to reduce residual bacteria is treatment with a cavity disinfectant. Various cavity disinfectants have been used in the recent past including chlorhexidine, fluoride gels, sodium hypochloride, and benzalkonium based solutions, but studies have reported adhesion could be impaired by a series of previous dentin treatments. Chlorhexidine is a broad spectrum antiseptic, and its use has been generalized over the past two decades for chemical control of bacterial plaque; the disinfection of therapeutic cavities has been adopted as a positive control for studies on bacterial growth or antibacterial activity.
According to the result of this study, using chlorhexidine prior to bonding did not adversely affect the sealing property of total etch adhesive system; however, doing so prior to the application of self etch single bottle adhesive system significantly increased microleakage scores. This may be indicative that there may have been some negative interactions between the remnants of the disinfectant and self etch bond. It has also been stated that the use of a cavity disinfectant with composite resin appears to be material-specific regarding interactions with various dentin bonding systems.\(^{13,14,15}\) Only a few studies have revealed an increased amount of microleakage when not rinsing chlorhexidine prior to dentin bonding agent application.\(^{16,17}\) Self-etching adhesives have a pH relatively higher than phosphoric acid etchants. Scanning electron microscope examination by Meiers and Kresin showed that cavity disinfectants applied to dentin surfaces were resistant to acidic conditioning.\(^{18}\) This acid-resistant layer might inhibit the ability of the weak acidic primers to effectively demineralize the dentin and hydrophilic resin to impregnate the dentinal surface.

Chlorhexidine is water soluble and dissociates at physiologic pH. It inhibits bacteria adherence to surfaces by competing with calcium for retention sites.\(^{19}\) It also gets adsorbed by the smear layer and makes the dentinal surface acid resistant. Our study indicates that the self etching primers might not effectively demineralize the acid resistant dentinal tubules and subsequently incorporate the chlorhexidine adsorbed smear layer into them.

It can be documented from this study that use of chlorhexidine as a cavity disinfectant has a definite beneficial role in etch and rinse adhesives, but it might adversely affect the resin dentin interface in single bottle self etching adhesives. Further clinical studies need to be conducted to verify the results obtained by the present study.

**SUMMARY AND CONCLUSIONS**

Within the limitations of this in-vitro study, it can be concluded that use of 2% chlorhexidine cavity disinfectant increases the microleakage in cavities restored with light cured composites using a single bottle self-etching adhesive system than total etch adhesive system.

**REFERENCES**


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