



Research Article

EVALUATION OF MICRO LEAKAGE IN COMPOSITES WITH NEWER DENTIN BONDING SYSTEMS BY DIRECT TECHNIQUE IN CLASS V CAVITIES: AN *IN-VITRO* FLUORESCENT DYE PENETRATION STUDY

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ABSTRACT

The objective of this study is to evaluate the micro leakage of class V lesions restored with composite material (Tetric Ceram) using one total etch bonding system and two self etch bonding systems using fluorescent dye penetration technique. Class V cavity were prepared on forty five extracted intact human molars. The teeth were divided randomly and equally into one control group and two experimental groups. In Control group Conventional etching was carried out with 37 % phosphoric acid (Total Etch) and bonded with Excite DSC. In Experimental groups Group 1- Self etching primer (AdheSE) was applied and cured: Group 2 –Self etching primer (Uni fil Bond) was applied and cured. All the 45 teeth were restored with Tetric Ceram. The specimens were immersed in Rhodamine 6G for 24 hours. Longitudinal sections were prepared and were subjected for microscopic evaluation. Results were statistically analyzed using ANOVA and Multiple comparison tests. The study showed that both the self etching primers showed significantly lesser micro leakage when compared to the total etch bonding system. Self-etching dentin bonding systems (Uni fil Bond and AdheSE) gave the better results in terms of less micro leakage when compared to the total – etch dentin bonding system when used with composites.

Keywords: Class V cavity; Micro leakage; Self etch adhesives; Total etch adhesives.

INTRODUCTION

Adhesive Dentistry has seen a dramatic transformation due to radical changes in technology, innovations and techniques. One of the challenges of restorative dentistry research is to develop adhesive restorative materials that provide an effective bond to dental tissues and consequently offer successful restorative treatment. Adhesive dentistry allows the use of preparations that preserve tooth substance, but in spite of many advances there still are shortcomings in composite adhesive techniques. For a restoration to fulfill its function it must be well adapted to the hard dental tissues. Shrinkage upon polymerization of the resin-based restoration and masticatory forces generate stresses within the adhesive layer that can result in gap formation between composite resin and the cavity walls. Marginal gap formation contributes to micro leakage permitting the passage of oral fluids and bacteria from the oral cavity and become a source of post-operative sensitivity, pulp inflammation and recurrent caries.¹⁻⁴ Restoration of cervical non carious as well as carious lesion has been a challenge to dental profession right from days of amalgam to the present day of composites. The restoration of Class V non carious /carious lesions involves three different substrate .i.e. enamel, dentin and cementum. Ideally any restorative material should bond to all of these three substrates and still have therapeutic advantages. However clinicians have frequently observed extensive shrinkage of resin composite during setting and immediate opening of the marginal seal. The risk for breakdown of marginal seal appeared to be strongly influenced by the size and shape of the cavity and the location as well as particular placement technique.⁵ Micro leakage is significant factor in evaluating the success of any restoration in mouth especially Class V cervical restorations. As of today not many studies are available to indicate effectiveness of self etching primers against

cervical dentin, enamel, cementum followed up with composite restorations. The aim of present study was to test the hypothesis that utilization of self etching primers should give better marginal seal with composite than with conventional resin bonding systems.

Objectives

The purpose of this investigation was to evaluate the micro leakage of class V lesions restored with composite material (Tetric Ceram) using one total etch bonding system and two self etch bonding systems using fluorescent dye penetration technique.

MATERIALS AND METHODS

45 freshly extracted human molar teeth were randomly selected for the study. The teeth were examined to ensure that they were free of fractures, carious lesions, non-cariou lesions, intrinsic or extrinsic stains. The teeth were cleaned, disinfected and handled as per the recommendations and guidelines laid down by OSHA and CDC. Class V cavities were prepared at the cemento-enamel junction on the buccal surfaces of each tooth using diamond burs in high speed water-cooled hand piece. The dimensions of each preparation were 3.0 mm in mesiodistal width and 1 mm above and below the cemento-enamel junction in height. The pulpal floor depth was 0.5 mm into dentin above CEJ and 1.0 to 1.5 mm into cementum below the CEJ. A 0.5 to 1.0 mm bevel was placed on the enamel cavo-surface margins above the CEJ with a flame shaped NO. 7901 – carbide bur. The teeth were divided randomly and equally into one control group and two experimental groups. In control group- The cavities were etched with 37 % phosphoric acid for 30 seconds (Total Etch; Ivoclar Vivadent) and bonded with Excite DSC (Ivoclar Vivadent) followed by restoration with Tetric Ceram (Ivoclar

Vivadent). In experimental groups: Group 1- self etching primer (AdheSE, Ivoclar Vivadent) was applied on the prepared cavities and cured for 20 seconds followed by restoration with Tetric Ceram. Group 2 –Self etching primer (Unifil Bond, GC America) was applied on the prepared cavities and cured for 20 seconds followed by restoration with Tetric Ceram. The teeth were then painted with nail polish except 1 mm around the restoration. The specimens were then immersed in Rhodamine 6G for 24 hours. After 24 h, the specimens were removed from the dye, washed with water and the nail polish was removed. Longitudinal sections were prepared from each tooth using a carbide disk and were subjected for microscopic evaluation. Figure 1, the amount of micro leakage was calculated directly under fluorescent microscope (Polyvar 2). The results were subjected to statistical analysis.

RESULTS

When the data obtained from the study were subjected to statistical analysis using SPSS Software (version 15.0) the following results were obtained.

- Analysis of variance (ANOVA Test) showed statistical significant difference between the three groups.
- Inter group comparison using Multiple Comparison Test (LSD) showed that there was a statistically significant difference between the any two specific groups tested:
 - I. When Unifil Bond and AdheSE were compared by using multiple comparison tests (Least Square distance (LSD)), the test showed statistical significance.
 - II. When Unifil Bond and Exite-Dsc were compared, by using multiple comparison tests (Least Square distance (LSD)), the test showed statistical significance.
 - III. When AdheSE and Exite-Dsc were compared, by using multiple comparison tests (Least Square distance (LSD)), the test showed statistical significance.

DISCUSSION

The classical concepts of operative dentistry has been challenged by contemporary restorative techniques based on the adhesive properties of tooth coloured restorative materials.⁶ The integrity and durability of marginal seal has always been a prominent concern in investigation of the performance of these tooth coloured restorative materials. The clinically undetectable passage of bacteria, fluids, molecules or ions between cavity walls and the restorative material has been defined as "micro leakage".⁷ Micro leakage is usually evaluated with *in vitro* experiments. Since new materials are constantly being introduced on to the market, short-term laboratory assessments are required because clinical evaluations are expensive, time consuming and require ethical approval.⁸ In contrast, *in vitro* studies such as micro leakage tests can provide important information on possible clinical performance of new restorative materials.⁹ A number of studies related to micro leakage shows that many and sometimes ingenious techniques have been developed to study marginal permeability and interface between the tooth and restoration. These studies emphasize the fact that the margins of restorations are not fixed, inert, impenetrable borders, as the clinician would like to view them but rather 'dynamic micro crevices which contain busy traffic of ions and molecules'. Several methods have been utilized for determining micro leakage, which includes radioactive isotopes, dyes, bacteria and scanning electron microscope.¹⁰ Eosin, Methylene blue, Methyl violet, Hematoxylin, Mercury chloride, Protosol soluble red, Aniline dye, Basic fuschin, Chromo type 2R, Crystal violet dye and fluorescent dyes are few of

the many dyes that have been used. Fluorescent dyes were found to be particularly useful as tracers for demonstration of leakage around dental restorations because a) They are detectable in dilute concentration or sensitive to UV light b) Easy to photograph. c) Contrast sharply with natural fluorescence of the teeth. d) Require short immersion periods, e) generally nontoxic. In the present investigation we have utilized Rhodamine 6G as fluorescent dye for evaluation of micro leakage on *in vitro* sample. A scan through the literature on toxicology and carcinogenesis study on Rhodamine 6G indicated marginal toxicity,¹¹ however there was no evidence of carcinogenic activity for male mice administered 1000-2000 ppm Rhodamine 6G in the diet. Although there was an equivocal incidence of carcinogenicity for female rats administered Rhodamine 6G.¹² Thus keeping this in mind the required precautions and barrier systems were advocated during the handling of this material. In the present study we have used two self etching primers, AdheSE (Ivoclar vivadent) and Unifil bond (GC) as two experimental groups and one total-etch bonding agent, Excite DSC (Ivoclar vivadent) as the control group. The composite filling material used for all the three groups were Tetric ceram (Ivoclar vivadent), a light-curing, highly-dispersed micro hybrid material. Results of the present study showed that none of the dentin bonding systems used could prevent micro leakage at the tooth restoration interface. (Figure 2) However the self etching primers (Two step prime and bond) showed comparatively lesser leakage than that of the total –etch bonding agents (Table 1). Analysis of variance (ANOVA Test) showed statistical significance between the three groups tested. The results of the present study is in accordance with the study conducted by B Maxon *et al* in 2004 in which the three self etching primers AdheSE, SE bond and Unifil bond) tested demonstrated less micro leakage compared to the total etch control (Excite Dsc) at the cervical margins.¹³ This may be because the Phosphoric acid used for etching is too aggressive resulting in exposing collagen so deeply that the dentin resin adhesive resin may not penetrate completely, leaving behind an infiltrated weak collagenous layer of dentin that is susceptible for long term degradation.^{14,15} Self etching primers in general having a pH of around 1 to 2 demineralises dentin only superficially (depth of 1 mm) thereby keeping residual hydroxyapatite still attached to collagen. Nevertheless sufficient porosity is created to obtain micromechanical interlocking through hybridization. The thickness of hybrid layer is much smaller than that produced by the etch and rinse approach but has proven to be of minor importance with regard to actual bonding effectiveness.¹⁶ The preservation of hydroxyapatite with the submicron hybrid layer may serve as a receptor for additional chemical bonding.¹⁷ This study demonstrated that effective bonding in class V lesions occurred with Unifil bond, a mild self etching primer when compared to AdheSE, a intermediate self etching primer. Poor marginal seal was demonstrated by Excite Dsc, thus indicated that Unifil bond was the dentin bonding material of choice among the three bonding systems to be used in class V situations to reduce micro leakage effectively.

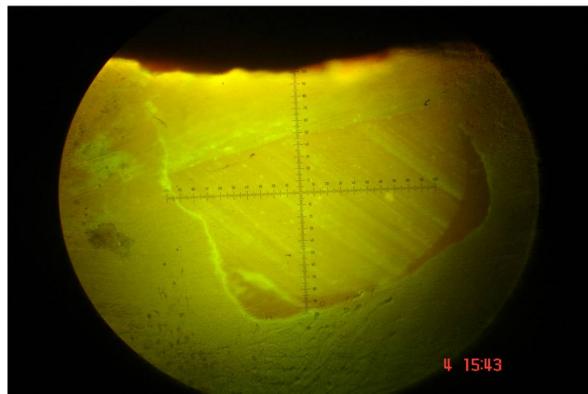
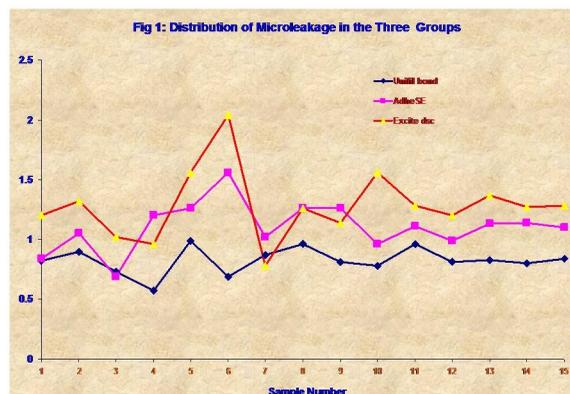
CONCLUSION

Within the limitations of the study the following conclusions were drawn:

- Self-etching dentin bonding systems (Unifil bond and AdheSE) gave the better results in terms of less micro leakage when compared to the total etch dentin bonding system when used with composites.
- Total etch dentin bonding system (Excite Dsc) demonstrated poorer marginal seal when used with composites.
- Among the two self etching primers Unifil bond demonstrated less of micro leakage in comparison to AdheSE.

Table 1: Mean values of micro leakage in the three groups

	N	Mean	SD
Unifil	15	.8241	.1091
AdheSE	15	1.1047	.2030
Excite-DSC	15	1.2827	.2929
	45	1.0705	.2838

**Figure 1: Microscopic view of specimen with Excite DSC****Figure 2: Distribution of Micro leakage in the three groups****REFERENCES**

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