

An in vitro comparative evaluation of microleakage in open sandwich technique in Class V restoration (A dye penetration study)

Alaa J. Khadhim, B.D.S, M.Sc. ⁽¹⁾

ABSTRACT

Background: The purpose of this *in vitro* study was to compare the microleakage at dentin margins of class V cavities filled with compomer alone and compomer lined with conventional glass ionomer cement or resin modified glass ionomer cement.

Materials and Methods: fifteen recently extracted human premolars were prepared with standardized box shaped class V cavities of 3.0 mm (mesial-distal), 2.0 mm (occlusal-gingival), and 2.0 mm depth with margins located on enamel and dentin/cementum on the buccal or lingual surfaces. The cavities were randomly assigned into three groups (n=10): Group I – compomer Dyract extra Detsply Detry GmbH (control); Group II – compomer Dyract extra Detsply Detry GmbH lined with conventional GIC (promedica Medifil). Group III – compomer Dyract extra Detsply Detry GmbH lined with RMGIC (3M ESPE Vitrebond). After being immersed in tap water for 24 h, the specimens were thermocycled (500 cycles, 5°-55°C, 30 sec dwell time) and immersed in a 0.5% basic fuchsin solution for 24 h. The restorations were sectioned longitudinally and gingival margins were evaluated for microleakage using a 0-4 scale. Data were subjected to the Kruskal-Wallis test and Mann-Whitney U tests at $p < 0.05$.

Results: a statistically significant difference among groups was observed. The RMGIC show the less gingival microleakage while the conventional GIC show the most microleakage.

Conclusion: The use of a RMGIC liner under composite in open sandwich technique minimizes the gingival microleakage, while the conventional GIC exhibited the contrary.

Keywords: RMGIC liner, Microleakage, Compomer resin. (J Bagh Coll Dentistry 2011; 23(sp. issue):1-4).

INTRODUCTION

One of the critical goals of adhesive dentistry is to restore the peripheral seal of dentin that is interrupted when enamel is lost as a result of developmental squal, trauma, caries or operative intervention such as preparatory excision ⁽¹⁾. However, cervical lesions have been a restorative challenge for dentists for many years. The complex morphology of Class V cavities with margins partly in enamel and partly in dentin presents a challenging scenario for the restorative material ⁽²⁾. The primary problem associated with the restoration of this kind of cavity is leakage at the gingival margin located in dentin ⁽³⁾. the so-called sandwich restoration or “composite-laminated GIC” technique has been used by clinicians to preserve the fluoride release mechanism and the chemical bond to tooth structure provided by the GIC and RMGIC, and to improve the esthetic and mechanical properties using a resin composite laminate ⁽⁴⁾.

The resin content of compomers and light-cured glass ionomers, which varies among available products, produces micro leakage shrinkage, which could cause an adverse effect on marginal adaptation, laboratory microleakage studies are a well-accepted method for screening of the marginal seal of adhesive restorative materials ⁽⁵⁾.

The purpose of this *in vitro* study was to compare the marginal microleakage of a compomer alone and compomer lined with conventional or resin modified light cured glass ionomer liner (open sandwich technique) after usage in class V preparations.

MATERIALS AND METHODS

Fifteen sound human premolars, extracted for orthodontic reasons were used. The teeth were cleaned of soft tissues and debris and stored in 0.9% normal saline in room temperature for a mean time of 2 months.

The samples were randomly divided into three groups of 5 teeth. In both buccal and lingual surfaces of all teeth, class V cavities were prepared with a No.12 diamond round fissure bur (Diatech Dental AG, Heerbrugg Switzerland) under water spray. The gingival margin of the cavity extended into cementum 1 mm below the cemento-enamel junction (CEJ). The cavity dimensions were 3mm in width (mesial-distal) 2mm in height (occlusal-gingival) and 2mm in depth. The cavities were cleaned, using pumice paste and then were rinsed with a water spray and gently dried.

All of the cavities in group 1 were filled with compomer (dyract extra detsply detry GmbH), in group 2 with a compomer lined with conventional glass ionomer cement (Medifil/Promedica) and in group 3 with a compomer lined with resin modified glass ionomer cement (vitrebond liner/ base 3M ESPE). In group 1,

(1) Department of conservative dentistry, collage of dentistry, university of Baghdad

enamel and dentin were etched with Super etch gel (37% phosphoric acid) for 15 sec., etching gel was applied to all of the prepared cavity wall approximately 0.5mm beyond unprepared tooth surface using dispensing tips for application. The etchant gel then removed with water spray for 10sec.Immediately after blotting excess water the prime and bond NT dental adhesive was applied for 20 seconds; excess liquid and solvent were removed by oil-free compressed air and light-cured for 10 seconds. The cavities were filled with dyract extra and then the restorations were light-cured for 20 seconds using a LED curing light (LATTE, china). In group II, the cavities were cleaned using a water spray, and then enamel was semi dried. The conventional GI (Medifil/ Promedica) was applied to the axial wall and gingival seat that extend to the external tooth (open sandwich technique).Next; the samples were filled with compomer like group A. In group III, the cavities were cleaned using a water spray, and then enamel was semi dried. The RMGI (vitrebond liner/ base 3M ESPE) was applied to the axial wall and gingival seat that extend to the external tooth and light-cured for 20 seconds. Next, the samples were filled with compomer like previous groups. The samples were kept in water at room temperature for 24 hours. Then, the samples were thermo cycled (50c-55oc) in synthetic saliva 500 times. After thermocycling, the teeth were dried and sealed with nail polish, 1mm short of the margins of each restoration. The coated teeth were then immersed into a 0.5% solution of basic fuchsine for 24 hours. Then they were rinsed, dried, and impeded in acrylic resin. Following that, all the samples were sectioned bucco-lingually through the center of the restorations with a slow-speed water-cooled D&Z diamond disc. Finally, they were visually examined for dye penetration along cavity walls by use of a stereomicroscope (Olympus at a magnification of X40).Scoring of dye penetration was assessed according to 0-4 scale

0= no dye penetration

1= dye penetration up to 1/3 along the gingival wall

2= dye penetration up to 2/3 along the gingival wall with out reaching the axial wall

3= dye penetration reaching the axial wall

4= dye penetration past the axial wall

RESULTS

The results on statistical analysis regarding the dentin margin are described in table one. The Kruskal Wallis test indicated a significant difference among the three experimental groups (H=16.6,P=000). The Mann-Whitney U test for

comparison of the mean rank of microleakage revealed that there was significant difference between group A and group B (U=4,P=0.001).The test also revealed that there was significant difference between group A and group C and also between group B and group C (U=000,P<0.001).

Table 1: Observed frequency of microleakage scores, percentages and statistical analysis

Score	Group A	Group B	Group C
	No. of teeth (%)	No. of teeth (%)	No. of teeth (%)
0	0(0.0)	0(00)	8(80.0)
1	6(60.0)	0(00)	2(20.0)
2	4(40.0)	2(20.0)	0(0.0)
3	0(0.0)	4(40.0)	0(0.0)
4	0(0.0)	4(40.0)	0(0.0)
Total	10	10	10
Mean score	1.4	3.2	0.2
SD	0.52	0.79	0.42

Table 2: Comparison of Micro leakage

	No. of teeth	Leakage score Mean	SD	H-value	Results of Mann Whitney test
A	10	1.4	0.52	16.6 P<0.001	A-B U=4 P<0.001
B	10	3.2	0.79		A-C U=0 P=000
C	10	0.2	0.42		B-C=000 P=000

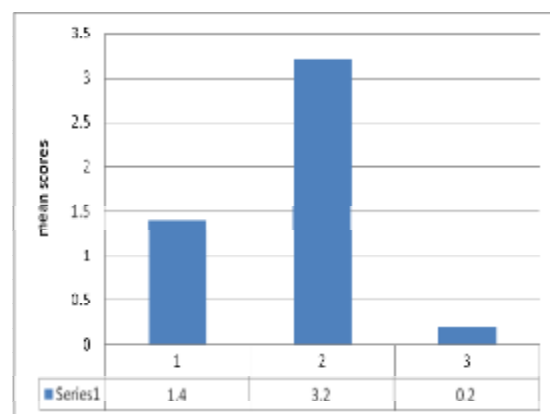


Figure 1: Mean microleakage scores in different groups

DISCUSSION

One of the most important aspects of restorative dentistry is the attachment of restorative material to the remaining part of the tooth structure ,the aspect of micro leakage has been the focus of much attention in assessing the

success of many restorative material used in the oral environment⁽⁶⁾.

For a lesion that is entirely bonded by enamel (i.e. an intra-enamel lesion) reserving the dentin seal becomes a matter of establishing a lasting interface between the resin and the enamel. Unfortunately, not all lesions of this type, and class V lesions commonly have gingival margins bounded by dentin, the strength and quality of the peripheral seal is therefore compromised and is susceptible to hydrolytic degradation⁽¹⁾.

While composite resin continues to be one of the materials of choice for the aesthetic restorations, they are not exempted from the phenomenon of microleakage. The probable causes of microleakage are polymerization shrinkage, high coefficient of thermal expansion leading to dimensional changes, and narrow enamel near CEJ⁽⁶⁾.

The use of GIC as an under filling material in conventional sandwich restoration reduces considerably the bulk resin composite used, thus the amount of polymerization shrinkage of the composite resin is decreased and the marginal adaptation may be improved⁽⁷⁾.

The purpose of the present study was to assess and compare in vitro, the sealing ability of different glass ionomer liners under composite resin restoration. The study was done using a stereomicroscope to assess microleakage.

In the present study group B showed the less microleakage when compared to group A and group C. Previous studies have shown that the inability of conventional GICs to produce an effective seal depends on two factors: 1) the material's sensitivity to moisture during placement and early set; and 2) the dehydration after setting, resulting in crazing and cracking⁽⁷⁾.

The maturation of GIC restorations is relatively slow. In the initial stages of the setting reaction, calcium ions are rapidly released and form primarily calcium salt bridges between polyacrylate chains within the cement. At this stage, both water uptake and water loss can occur, with the attendant clinical problems of water contamination and dehydration. Provisions must be made to maintain the water balance of restorations for the first 24 hours⁽⁸⁾.

The reason for less leakage of group C when compared to group A and group B in preventing of dye penetration beyond DEJ might be explained by the dual setting mechanism of RMGIC ensuring a more complete hardening of the material and higher fracture toughness when compared with conventional GIC and instant set property which prevents pull back of the material due to polymerization shrinkage⁽⁹⁾.

Stronger and less brittle hybrid materials have been produced by the addition of water-soluble or compatible monomers such as hydroxyethyl methacrylate (HEMA), capable of free radical polymerization (e.g., via light-curing) to GIC formulations⁽⁸⁾.

Microleakage seen in the group A might have occurred because of the higher resin content of compomer compared to the resin modified glass ionomer. As a result, polymerization shrinkage was noticed to be further accompanied by higher microleakage in the gingival margin⁽⁴⁾ and could be due to unreliability of dentin bonding due to variability in dentin substrates, presence of outward fluid movement within the dentinal tubules, and technique sensitivity⁽⁶⁾.

Our results agree with the study of Florita et al who evaluate the gingival microleakage of a composite lined with different materials (bonded amalgam, glass ionomer, resin modified glass ionomer and compomer) and found a significant difference between these restorations⁽¹⁰⁾. This result agree with the result of Bona et al⁽⁸⁾, Ersin et al⁽¹¹⁾ and Hubel et al⁽¹²⁾.

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