***ISSN:* 1812–1217**

The Early Microleakage of a Fflowable Composite in Class V Restorations

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ABSTRACT

Aims: To evaluate microleakage in Class V restorations, which were restored with flowable composites compared to hybrid composite and to evaluate the difference of microleakage between occlusal and gingival margins. **Materials and methods:** Forty five non–carious upper premolar teeth were randomly distributed into 3 groups of 15 teeth each. Class V preparations were made in the buccal surfaces of each tooth and restored by the use of two flowable composites (Tetric and Megafill) and the third group with hybrid composite (Tetric Ceram). The specimens were stored in distilled water at 37 °C for 24 hours. The specimens were then thermocycled manually for 100 times between 5 $\pm$ 2 °C and 55 $\pm$ 2 °C. All restored teeth were immersed in 0.2% methylene blue dye for 24 hours and sectioned buccolingually with a finishing diamond wheel. Dye penetration was scored by use of a stereoscopic microscope under magnification of ×20. **Results:** The flowable composites had a significant effect on reducing the microleakage at gingival margin (p= 0.01). The type of material had no significant effect at occlusal margin (p= 0.454). The occlusal margin had significantly lower microleakage than gingival margin (p= 0.001). **Conclusions:** The flowable composites can reduce the microleakage at gingival margins, but non of the restorative materials completely sealed the tooth restoration interface.

Key Words: Microleakage, flowable composite, marginal adaptation.

Al–Nori AKh. The Early Microleakage of A flowable Composite in Class V Restorations. *Al–Rafidain Dent J*. 2009; 9(2): 156–161.

Received: 31/7/2007 ***Sent to Referees:*** 15/8/2007 ***Accepted for Publication:*** 8/10/2007

INTRODUCTION

Microleakage of composite refers to very small or microscopic openings between the margins of the composite restoration and the tooth structure (1). Microleakage can result in bacteria penetrating teeth and dentinal tubules where they and their toxins can irritate the pulp and lead to pulpitis, secondary decay and discolouration of tooth structure (2, 3).

Marginal adaptation becomes more difficult in Class V cavities where there is little or no enamel at the gingival margin, and the restoration comes in contact with cementum (4). This decreases adhesion considerably, facilitating the dislodgement of the material toward occlusal during polymerization because adhesion of a composite resin to enamel surface is better when compared to dentin surface (5, 6).

The coefficient of thermal expansion for the resin and tooth structure is different. Varying temperatures cause volumetric changes in the resin. The resin can undergo thermal expansion and contraction while inside a tooth: Temperature changes in the mouth that result from food or drink which can change the resin's size. If the tooth can not tolerate the change, an open margin which can lead to microleakage (7–10).

Polymerization shrinkage is one of the major differences between the physical properties of the tooth and composite. During the polymerization of the resin composite, the density of the resin composite mass changes, resulting in a volumetric changes (11–13). As resin composite set, they shrink inward toward the center of the composite core and may pull away from tooth structure, generating an open margin or void (14, 15).

The amount of matrix can influence the degree of polymerization contraction (16, 17). The flowable composites have a lower percentage of inorganic fillers, and therefore a higher percentage of matrix than traditional hybrid composites providing high fluidity (18). Thus, it could be thought that they could contract more during polymerization and create more tension in the union agents than traditional composites, resulting in greater microleakage [19, 20]. On the other hand, some authors have theorized that because of the low modulus of elasticity and the increased bond strength presented by the flowable composites, there may be less polymerizetion shrinkage, resulting in lower microleakage [21, 22].

The aim of this research was to evaluate the microleakage in Class V restorations, which were restored with flowable composites compared to hybrid composite used as a control.

MATERIALS AND METHODS

Forty five freshly extracted non–carious upper premolar teeth were extracted for orthodontic purposes and stored in normal saline at room temperature. The teeth were scaled and polished with non–fluoridated pumice and rubber cup with contra–angle hand piece at low speed to remove the plaque and organic debris. Afterwards, the teeth were washed in running water. Then, visual examination of the teeth was done by a magnifying eye lens and light from light cure device to exclude the teeth that have cracks. Forty five teeth were selected and stored in normal physiological saline at room tem-perature. Round shaped Class V cavities were prepared on the lower third of buccal surface of each tooth with a high speed hand piece under water cooling using a tungsten carbide fissure bur No. 330. The bur was changed with a new one after each five cavity preparations. Each cavity preparation was received a 0.5 mm wide bevel at a 45° angle to the edge of the enamel margins (occlusal margin) with a diamond bur. Gingival margins ended at a 90° angle with the longitudinal surface of the teeth below the cemento–enamel jun-ction. Using a low speed hand piece and a stainless steel fissure bur (No. 38–010 Komet Co. West Germany), the cavity walls were finished. The cavities were approximately 3 mm diameter and 2 mm deep (Figure 1). These dimensions were checked using a digital vernier (Electronic digital vernier caliper, Lezaco, China).

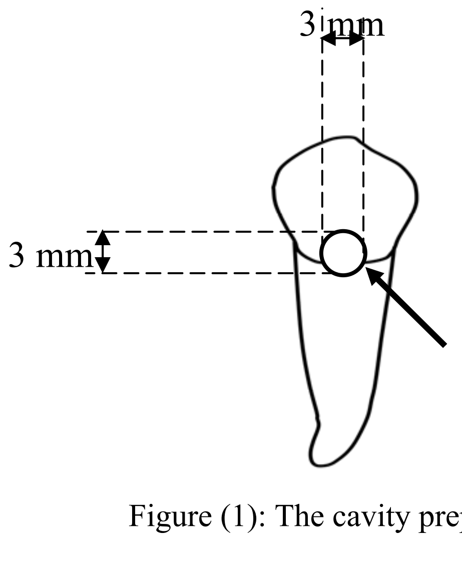

Figure (1): The cavity preparation.

The teeth were divided into three groups of fifteen teeth each. The cavities were restored according to the manufacturer's recommendations of each composite. In all groups, the total etch technique was performed with a 37% phosphoric acid gel. The acid was applied initially to the enamel margins and then extended from superficial to deep dentin and allow to react for 15 seconds. Then, thoroughly rinse off the phosphoric acid with water for 15 seconds and dry the tooth surface with oil free air. Avoid dehydrating the dentin. The enamel and dentin were saturated with a generous amount of Excite bonding agent (Ivoclar Vivadent AG, Fl 9494 Schaan/ Liechtenstein) using a Vivadent applicator for 10 seconds. The ideal adhesive surface prior to restorative placement should have a uniform, glossy appearance and be solvent free. This may be achieved by using a gentle clean dry stream of air for 1–3 seconds, approximately 5 mm from the preparation surface, then curing of Excite for 20 seconds with a conventional halogen curing unit (Quayle Dental, England) was done.

In group 1, the Tetric flowable composite (Ivoclar Vivadent AG, Fl 9494 Schaan/ Liechtenstein) was inserted with the needle provided by the manufacturer into the preparations in one increment and adaptation of the composite material was done by a celluloid strip, curing of composite was done for 20 seconds.

In group 2, the Megafill flow composite (Megadenta Dental Produkt GmbH D.01454 Radeberg, Germany) was used as described in group 1.

In group 3, the Tetric Ceram composite (Ivoclar Vivadent AG, Fl 9494 Schaan/ Liechtenstein) was used to restore the preparations. The composite material was placed in one increment and adapted by a celluloid strip, curing of composite was done for 20 seconds.

Following storage in distilled water at 37 °C in an incubator for 24 hours, the fillings were finished and polished with coarse, medium, fine and ultra fine Soflex disks (RIHANI Inc. 14 SUEZ St. CRANSTON R.I. 02920 USA).

The specimens were then thermocycled manually for 100 times between 5 ± 2 °C and 55 ± 2 °C.

After thermocycling, the apices of the teeth were closed with cold cure acrylic resin and the external surfaces of all specimens were coated with two layers of nail varnish except 1 mm around the restoration. All coated specimens were immersed in 0.2% methylene blue dye and stored at 37 °C for 24 hours. All the specimens were cleaned, dried and embedded individually in block of cold cure acrylic resin. Each of the specimens were sectioned longitudinally (in a bucco–lingual direction) through the middle center of the restoration by slow speed water cooled finishing diamond wheel (KG Sorensen Ind. Sao Paolo, Brazil).

Dye penetration was evaluated visually along occlusal and gingival margins using stereoscopic microscope (Carl Zeiss, Germany) under magnification of ×20.

One investigator scored all interfaces according to the following criteria:

Score 0: No evidence of dye penetration.
Score 1: Dye penetration up to 1/3 of cavity wall.
Score 2: Dye penetration more than 1/3 of cavity wall without reaching axio–gingival or axio–occlusal line angle.
Score 3: Dye penetration reaching the axial wall (Figure 2).

Statistical analysis of the results was obtained by Kruskal–Wallis test to compare the effect of the type of restorative materials and Kolmogorov–Smirnov test to compare the occlusal and gingival margins

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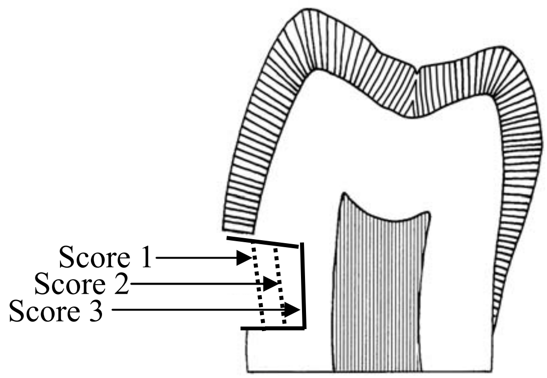

Figure (2): Scoring system employed in evaluation of microleakage.

Score 1: Dye penetration up to 1/3 of cavity wall; *Score 2*: Dye penetration more than 1/3 of cavity wall without reaching axial wall; *Score 3*: Dye penetration reaching axial wall.

RESULTS

The scores of microleakage at occlusal and gingival margins of the three groups were listed in Tables (1 and 2).

Table (1): (gingival margin) showed a significant difference in the microleakage among the three tested groups. Group III (conventional composite) was the worst one (p= 0.001)

Table (2): (occlusal margin) showed no significant difference among the three tested groups (p= 0.454).

Table (3): showed a significant difference of microleakage between occlusal and gingival margins; that's to say, the gingival margins presented more microleakage than the occlusal margins (p= 0.001).

Table (1): Comparison of scores of microleakage at gingival margins.

Score	Group 1	Group 2	Group 3
0	6	5	0
1	2	7	1
2	6	2	10
3	1	1	4

Kruskal–Wallis test: χ^2= 14.135; df= 2; p= 0.001; Significant.

Table (2): Comparison of scores of microleakage at occlusal margins.

Score	Group 1	Group 2	Group 3
0	9	6	7
1	5	6	6
2	1	3	2
3	0	0	0

Kruskal–Wallis test: χ^2= 1.581; df= 2; p= 0.454; Not significant.

Table (3): Comparison of scores of microleakage between gingival and occlusal margins.

Score	Gingival	Occlusal
0	11	22
1	10	17
2	18	6
3	6	0

Kolmogorov–Smirnov test: Z= 1.897; D (absolute)= 0.400; p= 0.001; Significant.

DISCUSSION

The present research demonstrated that the marginal adaptation to dentin or cementum at the gingival margin was improved by the use of flowable compos-ites where the gingival margin located below the cemento–enamel junction. The low elastic modulus and high wettability of flowable composites compared to conventional composites, made this kind of material absorb the shrinkage stress during the polymerization of resin composites [18, 23]. Also, flowable composites have low viscosity enough to be dispensed from a syringe and needle provided by the manufacturer, giving the operator a greater chance to prevent voids at the interface, so reduce the likelihood of microleakage [24]. The finding of the present research (improvement of marginal adaptation to dentin at gingival margin by the use of flowable composites) was in agreement with other studies [25–27], and disagreed with others [15, 28].

In the present research, the gingival margins showed greater scores of microleakage than occlusal margins. This may be due to the beveling enamel at occlusal margins which increases the surface area of the preparation for bonding and with the use of 37% phosphoric acid gel (total etch technique) and bonding agent, a resin enamel hybrid layer formed while strengthening the marginal adaptation of the resin composites at occlusal margins and reducing the chance of microleakage [1, 29]. The gingival margins of Class V restoration in this research may be at cementum or dentin where there is no enamel. The adhesion between composites and dentin is not as strong as with enamel [4]. Also, the difference in thermal expansion between dentin and composite is larger than the difference between enamel and composite [30]. This difference may be an additional contributing factor to the increased leakage at the dentin margins. Therefore, the material can be dislodged, causing a bad adaptation of the restoration to the gingival margin. This finding was in agreement with other studies [28, 31].

The present research was designed to evaluate the early microleakage after 24 hours of flowable composites. Other researches may be suggested to evaluate the microleakage of flowable composite after long time of aging, one or six months.

CONCLUSIONS

The flowable composites can reduce the microleakage at gingival margins, but there is no statistical difference of microleakage between flowable and hybrid composites at occlusal margin. The gingival margins presented more microleakage than the occlusal margins.

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