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AN IN-VITRO EVALUATION OF MICROLEAKAGE IN METHACRYLATE BASED FLOWABLE COMPOSITE AND RESIN MODIFIED GLASS IONOMER CEMENT IN CLASS II RESTORATION

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ABSTRACT

Aim: The aim and objective of this study is to evaluate the microleakage of methacrylate based flowable composite (SDR™ posterior bulk fill flowable base) and a Resin modified Glass Ionomer Cement (FUJI II™ LC®) at the interface of tooth and the restoration in Class II design.
Subjects and Methods: Ten extracted human maxillary molars were selected for this study. Class II cavities were prepared on both mesial and distal surfaces, making them twenty prepared cavities. These samples were divided into two groups and restored by the two materials respectively (n=10). Following this microleakage of these materials were evaluated by dye penetration under stereomicroscope.
Statistical Analysis: Microleakage values were analyzed using Post- hoc Test (P= 0.05).
Results: SDR shows a good sealing ability (5.9863) to the tooth surface thus minimising the microleakage when compared to the Fuji II LC (5.4223).
Conclusion: Out of the two-materials methacrylate based flowable composite demonstrated less microleakage compared to Resin Modified Glass Ionomer Cement.

INTRODUCTION

Due to presence of bacteria from the plaque on the surface of restoration, micro leaking is seen into the interfacial space[1,2]. Microleakage is basically the clinically undetectable passage of bacteria, fluids, molecules or ions between a cavity wall and the restorative material applied to it[3]. Pulpal irritation, secondary caries and marginal discoloration are the ill effects of microleakage[4-6]. Microleakage occurring due to polymerization shrinkage has been a major problem in composite restorations[7]. Over the past fifty years, a lot of changes have occurred in the development and availability of different dental restorative materials like Amalgam, GIC and Composites etc.

A wide range of composite resin materials have gained popularity in last decade, amongst which flowable composite is one of them. These kinds of composite materials have a large number of properties like lower viscosity due to reduced filler load[8], reduced microleakage[9] and reduced formation of voids[10].

DENTSPLY have developed a methacrylate-based flowable composite material SDR™ posterior bulk fill flowable base (Dentsply Caulk, Miliford, DE, USA) that significantly reduces polymerization stress independent of the filler load. The polymerization stress is as low as 1.5 MPa. They allow highly efficient and safe cavity filling technique. They have advantage of maximum increment thickness of 4mm and also, they are compatible with all methacrylate- based adhesive system.

Glass ionomer cements have coefficient of thermal expansion matching with the tooth structure. These cements provide good marginal sealing, little microleakage and a high retention rate. Conventional glass ionomers have a number of clinical limitations, including dehydration during initial setting, prolonged setting time and rough surface texture that can hamper mechanical resistance[11]. A light-cured resin modified glass ionomer (RMGIC) was introduced to overcome the shortcomings of a conventional glass ionomer cement.

One of the most popular brands for RMGIC is FUJI II™ LC® (GC America Inc.). Which has characteristics like natural chemical bond to the tooth structure, fluoride release, minimal expansion or contraction when subjected to extreme temperatures, excellent aesthetics, improved abrasion resistance and smaller particle size.

MATERIALS AND METHODS

Freshly extracted human, non-carious maxillary molars were cleaned thoroughly and inspected for any caries or cracks due to extraction. Standardized Class II (box only) cavities were prepared on both mesial and distal aspect of ten extracted human maxillary molars, making them twenty prepared cavities.

All the prepared samples (twenty prepared cavities) were randomly divided into two groups. Group I cavities (n=10) were restored by SDR™ posterior bulk fill flowable base (Dentsply Caulk, Miliford, DE, USA) and Group II cavities (n=10) were restored by FUJI II™ LC® (GC America Inc.).

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Cavity restoration in Group I was carried out by first etching the prepared surface by 37% phosphoric acid (SwissTec SL Etchant) for 15 seconds, followed by application of bonding agent Prime and Bond NT (Dentsply De Trey, Konstanz, Germany), which was light cured for 10 seconds. The cavities were then restored with SDR™ posterior bulk fill flowable base and light cured for 20 seconds with LED curing light (Woodpecker iLED light curing unit).

Group II cavities were restored by first applying GC Dentin conditioner (GC America Inc.) to all the walls of prepared cavity for 15 seconds, through rinsing with water was done for 30 seconds while removing the excess with a dry tissue paper. The material was mixed according to the manufacturers instruction and placed in the cavity with a cement spatula. After removal of the excess, the cavity was light cured with LED curing light.

After completion of the restorative procedure, incubation of the samples was performed at 37^0C for 24 hours. In order to stimulate temperature fluctuations, found in oral cavity the samples were subjected to 500 thermocycles in a thermocycling machine (Thermomixer comfort by Eppendorf) at temperature range of $5^0C \pm 2^{0C}$ and $55^0C \pm 2^0C$ with a dwell time of 30 sec. The samples were immersed in methylene blue solution (fisher scientific by Thermo Fisher Scientific) at normal room temperature after coating it with a nail varnish (leaving the restorative part of the tooth). After 24 hours, the samples were removed out of the dye and thoroughly washed for 5 minutes to remove excess of dye on the external surface of the teeth. The samples were sectioned mesiodistally from centre of the restoration so that it is divided into two equal halves in order to evaluate the dye penetration at the tooth and restoration interface. The depth of dye penetration was observed at the cervical interface between the tooth and the restoration under stereomicroscopes at 30x magnification (Nikon SMZ 1500 *Zoom* Stereomicroscope). *Assessment of microleakage was done using ISO microleakage scoring system (Figure 1) [ISO/TS 11405:2003].*

The cervical microleakage scoring criterion was

0 = No dye penetration
1 = Dye penetration into ½ of the cervical wall
2 = Dye penetration into all the cervical wall
3 = Dye penetration into cervical and axial wall towards pulp

The degree of dye penetration was independently scored by two examiners who were blind to the procedure. In case of disagreement between their evaluations, the worst score was considered. The data collected was tabulated and subjected to statistical analysis to compare the microleakage using Post-hoc Test.

RESULTS

Samples in SDR groups show no/ minimal dye penetration on the basis of scoring criterion compared to Fuji II LC group (Table 1).

Table 1 Distribution of microleakage scores along the cervical margin of tooth/ restoration interface in the two groups

Dye penetration scores	Group I (n=10)	Group 2 (n=10)
Score 0	6	2
Score 1	1	2
Score 2	1	2
Score 3	2	4

Table 2 Maximum upper and lower values, Standard deviation and comparison of both Groups done by Post hoc Test

Group	Upper value	Lower value	Standard Deviation	Comparison of two groups Subset for alpha= .05	
				1	2
Group I (SDR) n= 10	6	1	2.38		5.9863
Group II (Fuji II LC) n= 10	4	2	1.00	5.4223	

SDR shows a good sealing ability (5.9863) to the tooth surface thus minimising the microleakage when compared to the Fuji II LC (5.4223) [Table 2].

DISCUSSION

The result of the present study showed that SDR™ posterior bulk fill flowable base had a lower microleakage than FUJI II™ LC®. The marginal gaps permit microorganisms to pass through the tooth/restoration interface. Due to long-term biochemical reaction within different materials and the oral environment, there is a continuous progression of microleakage. Composite constitutes of monomers link together to form network when exposed to light. The shrinkage seen due to polymerization is caused by placing greater volume of composite during the bulk filling technique. Composites placed in incremental technique can lead to a better sealing ability of material. The modified urethane dimethacrylate resin SDR™ posterior bulk fill flowable base has demonstrated a relatively slow radical polymerization rate. These results were similar to studies conducted earlier[12, 13]. This material have low filler load (68% weight), low modulus of elasticity and also lower levels of polymerization stress when compared to the traditional flowable composite[14]. They are indicated to be used for bulk application in direct composite restorations[15].

Group II samples which were restored with Fuji II LC on the contrary showed an elevated rate of microleakage. There is an immense gap formation at tooth restoration interface when this kind of resin modified glass ionomer cements is exposed to curing light[16]. Fuji II LC is a two-bottle system, so there are more chances of porosities while mixing and placing in the cavity[17]. A study conducted also explained the formation of ‘absorption layer’ which is a non-particulate layer of solid material within the body of Fuji II LC adjacent to dentin[18]. It explains the formation of gap thus giving rise to microleakage at the surface, this layer doesn’t appear adjacent to enamel.

In vitro screening of dental materials is a key method to set an ideal about the maximum microleakage that could be present in vivo[19]. A dye penetration test was used for evaluation of microleakage as it is simple, relatively cheap and also provide quantitative and comparable results[20,21].

Studies related to microleakage fails to stimulate oral environment, so thermocycling is a widely-used method to stimulate the effects that dental materials are put through in the mouth[22]. An established method to observe microleakage is by stereomicroscope as it provides us with clear images with the help of recent image processors and software.

CONCLUSION

Based on this above study, while evaluating the microleakage of the test materials along the cervical margin, it was concluded that amongst the two materials used as bulk filling materials tested SDR™ posterior bulk fill flowable base had a lower microleakage values than FUJI II™ LC®.

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Conflicts of interest:

There are no conflicts of interest.

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