BULK-FILL RESIN-BASED COMPOSITES: MICROLEAKAGE OF CLASS II RESTORATIONS

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ABSTRACT

The aim of this study was to evaluate in vitro microleakage in class II restorations, using or not a fluid resin low shrinkage. Twenty human molars were used and each tooth cavities 2 slot. The teeth were randomly divided into 4 groups : G1E (enamel) - SDR + TPH3 (Dentsply Caulk); G1D (dentin) - SDR + TPH3 (Dentsply Caulk) and G2E - TPH3 (Dentsply Caulk) and G2D - TPH3 (Dentsply Caulk) . Subjected to thermal cycling (10.000 cycles), immersed in 0.5% basic fuchsin for 24 horas/37 ^{0}C. The analysis of the degree of infiltration done by optical microscope (magnification 15X). Data were statistically analyzed using the Student *t* test. The result showed that there were differences between the dental tissues (G1E - G2E X G1D - G2D) with greater infiltration for completion in dentin. To use the fill resin SureFil SDR no difference. The fluid resin low shrinkage (bulk fill composite) had the same results of microleakage in class II cavities when compared with the conventional technique of restoration with composite resin.

KEYWORDS: Dental infiltration, Composite Resins, Dental Marginal Adaptation.

1. INTRODUCTION

The big challenge in the making of a restoration with composite resin is the correct performance of the restorative technique respecting and knowing specific material characteristics, such as polymerization shrinkage which can cause serious problems in marginal sealing of that restoration. This microleakage characterized by the passage of bacteria, fluids, molecules and ions between the cavity wall and the restorative material, resulting in tooth sensitivity, recurrent caries and pulp damage to[1].

To control the marginal and consequent increased longevity of the restoration infiltration is essential to forming a union effective interface between tooth and restorative material[2,3]. The formation of the hybrid layer, which is the interface to dentin must be able to prevent the ingress of fluids and bacterial products that may lead to post- operative sensitivity, mismatch of the restoration margins secondary caries and consequently failure treatment[4]. The leakage is related mainly to polymerization shrinkage and stiffness of the restorative material that can lead to marginal leakage and occlusal maladjustments, until the loss of restoration and recurrent caries[5,6].

Direct resin restorations in class II preparations are a great challenge for the Dental Surgeon, for the control of polymerization shrinkage of composite resin preparations with the cervical margin in dentin exhibit more susceptibility to occurrence of leakage[1]. To lessen the effects of polymerization shrinkage, several techniques have been proposed, among them are: the insertion of the composite in increments[1,6] resin, using different protocols polymerization[7] and the association of different materials[6,7].

In an attempt to better dissipate stress, minimizing the stresses generated on the interface of the restoration, have emerged in the market various restorative materials. This is possible by modifying some physical and mechanical properties of these materials. Notable fluid resins fill only (bulk fill composite), whose employment associated with conventional composites would bring great benefits for esthetic restorations in posterior teeth. The fluid filling resins have a lower concentration of charge, great flow with excellent adaptation to the cavity (some still have the ability to self-leveling) and low modulus of elasticity, which in theory would support and better dissipate stress generated by thermal stresses and masticatory , and thereby caused microfractures in the bond line and favoring marginal sealing[8]. Still possess the ability to fill the cavity without the need for overlapping layers, eliminating the stratified incremental technique[2].

This work aimed to evaluate laboratory after thermal cycling test, the influence of using fluid resin filler in combination with composite on the marginal sealing in preparation class II ending in dentin and enamel resin.

2. MATERIAL AND METHODS

It is laboratory in vitro assay developed intentionally defined and standardized sample of human molar teeth extracted and properly donated by Bank of teeth on the advice and approval of the Research Ethics Committee number 301 297 of 07/06/2013.

Exactly 20 freshly extracted human molars, teeth donated by Bank of the State University of Maringa, were used in this research; EMU with no cracks or fractures of enamel, cleaned and stored in a solution of 10% formalin for 72 hours, passing if so, the subsequent storage in saline solution of 0.9% sodium chloride.

The teeth were rinsed thoroughly with water and cleaned with pumice and rubber cup to then be held Class II mesio - occlusal- distal tooth in each, ending on cervical dentin and enamel type standardized cavities. The molars were suitably adapted (with wear through diamond drills) and fixed to the dental mannequin (Jon) with wax, the location of the upper 2nd molar removed therefrom.

The class II preparations MOD (mesial-occlusal-distal) were standardized following a cavity geometry by using 4137 diamond bur (KG Sorensen) in high speed refrigerated air-water spray and presenting Finally, the following dimensions: occluded pulp with 03 mm bucco-palatal with 03 mm and axial depending on the cervical end of the preparation.

The occlusal-cervical dimension was standardized using as reference the cementoenamel line, ie , the distal preparation was located 01 mm below this line (ending in enamel) and preparation mesial to 01 mm beyond this line (ending in cervical dentin) . After cavity preparation was adapted Unimatrix metallic matrix (TDV Dental Ltda.) and plastic wedges.

All cavities were conditioned with a solution of 37% phosphoric acid gel (Dentsply) for 30 seconds , washed with water jet for over 30s and dried with a gentle stream of air leaving the moistened surface. After using disposable brush (Microbrush), the XP - Bond adhesive system (Dentsply) was applied in two consecutive layers and light cured through the curing unit Optilight Max (Gnatus) for 20s.

The samples were divided into 02 groups of 10 teeth each, according to the restorative material used in the preparation:

Group 01: Resin fluid fill SureFil SDR (Dentsply) + TPH3 Composite resin (Dentsply);

Group 02: Composite resin monohybrid TPH3 (Dentsply).

In Group 01 to fill fluid resin SureFil SDR (Dentsply) was used, with the aid of a syringe Centrix, based only on the pulp, and cervical axial setting of the preparations reference to a thickness of 01 mm in wall pulp walls. The restoration was completed using composite TPH3 (Dentsply) the other remaining 02 mm in two increments resin.

The Group 02 has been inserted only TPH3 composite (Dentsply) in three increments.

For all groups, after polymerization of the last increment of resin composite, the finish of the margins of the restoration was accomplished: first with a scalpel blade paragraph 150C (Swann Morton), to remove any excess material - especially in the region cervical and then polished with Sof - Lex (3M) discs sequential particle size. These procedures was made to promote the smooth and free of restorations excesses.

After finishing and polishing of 20 preparations, the specimens were stored in distilled water at 37 º C for 07 days until being subjected to thermal cycling with thermal cycler machine (New Ethics , Model 521 -E Ethics Equipment Scientific S / A, São Paulo, SP, Brazil). The cycling consisted of 10,000 cycles of 30 seconds each, with an interval of 3 seconds in temperatures of 5 ºC and 55 ºC. The number of cycles corresponds to aging the samples at 12 months[9].

Upon completion of thermocycling the teeth were covered with two layers of nail polish white (Risqué) except for 01 mm below and above the interface between the tooth/ restoration. This procedure was intended to prevent the penetration of dye into unwanted areas now covered by enamel, as the apical foramen.

Following the teeth were immersed in 0.5 % basic fuchsin for 2 h to show potential leaks in the tooth -resin interface.

Properly stained teeth were sectioned in ISOMET 1000 Precision Cutting Saw machine (Buehler Lake Bluff, USA) in a mesio - distal direction at a speed of 300 rpm under constant refrigeration and each sample was separated through an identification code with pen black overhead projector (RCF code for Group 01 and Group 02 for RC code) to facilitate their subsequent measurement.

The microleakage at the interface restoration / enamel and restoration / dentin was assessed qualitatively. The rate of dye penetration was assigned, adopting the approach of various scores, previously determined under Bassiouny (Figure 1):

0 - No infiltration;

1 - Infiltration of the dye to half of the gingival wall;

2 - Infiltration across gingival part reaching the axial wall;

3 - Infiltration of the axial wall and into the pulp.

Cuts greater degree of infiltration corresponding to each specimen were selected and observed by three calibrated examiners. These examiners did not participate in earlier stages of this research, nor knew the code for the identification of the specimens (Figure 1).

Figure 1. stained and sectioned samples.

The analyzes were performed with the aid of an optical measuring microscope (Toolmaker's Microscope Mitutoyo, Japan) using a 15x objective.

The composition of the resins used was summarized in the Table 1.

Table 1. Composition of the resins used.

TPH3	Surefil SDR
Glass aluminum silicate, barium fluoride	Glass silanized barium aluminum borosilicate
Glass strontium aluminum silicate fluorine	Glass silanized fluoride barium aluminum borosilicate
Resin modified urethane dimethacrylate	BisGMA dimethacrylate
Ethoxylated bisphenol A dimethacrylate (EBPADMA)	Silica
triethylene glycol dimethacrylate (TEGDMA)	EDAB
Camphorquinone (CQ) as photoinitiator	other excipients
Butyl hydroxy toluene	
UV stabilizers	
Titanium dioxide	
Iron oxide pigments	

The samples were analyzed individually by each examiner and, in case of disagreement between the examiners, they gathered for a new evaluation to obtain agreement on a common outcome. Data were statistically analyzed using the Student *t* test with significance level of 5 %.

3. RESULTS

The results of agreement of the three examined were recorded in a table for later statistical analysis (Table 2).

Table 2. Values measured under an optical microscope after evaluation by examiners.

		Sample - Results in agreement									
		01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**
Group 01 (SDR+THP3)	Enamel (G1E)	2	0	1	1	1	1	1	1	0	3
	Dentin (G1D)	2	2	2	2	2	2	2	2	2	2
Grupo 02 (THP3)	Enamel (G2E)	0	0	1	2	1	3	1	2	1	0
	Dentin (G2D)	2	2	2	3	2	3	1	2	0	0

Through the Student t test with significance level of 5 %, the same structures (enamel X dentin enamel and dentin) were compared and no significant difference between Groups 01 and 02 ($p > 0.05$). When comparing different structures, ie, X enamel dentine was no significant difference between groups ($p < 0.05$) (Table 3).

Table 3. Statistical analysis of the results.

P value	**Compared Statistical Structures**	**Significance**
0,5	SDR+TPH3 Enamel (G1E) X TPH3 Enamel (G2E)	No difference
0,196911	SDR+THP3 Dentin (G1D) X TPH3 Dentin (G2D)	No difference
0,000788	Enamel (G1E+G2E) X Dentin (G1D+G2D)	With difference

4. DISCUSSION

Conducting experiments involving restorative materials and techniques described in the literature are very for its relevance and clinical applicability.

Class II termination involving dentin type cavities has been studied by numerous authors[1,4,8,10,11,12].

The class II type wells have cervical margin in dentin, have a determining factor for longevity of same, the occurrence of infiltration by marginal leakage. In an attempt to minimize problems inherent restorations have appeared in numerous market restorative materials with physical and mechanical properties seeking to better dissipate stress, thereby causing a lower leakage[8].

With the release of fluid composites with low shrinkage stress (bulk fill composite), the posterior teeth in dentistry has totally changed, allowing the cavity filling in a single layer and with greater ease, which makes the procedure much simpler, practical and fast[13].

According to Sadeghi and Lynch in 2009[14], fluid resin is used as the first increase in gingival and axial wall for class II restorations decrease microleakage. This result was obtained using only conventional fluid resins, different from the present study that evaluated the fluid resin low shrinkage Surefil SDR as a basis for liner.

Similarly, Reddy *et al*., 2013[3], compared class II restorations using flowable composite in different thicknesses. Fifty molars underwent type and class II preparations were randomly divided into five groups according to the restoration performed: Group I, P60 (no resin flow), group II, ultrathin coating resin flow (0.5 -1mm) with coverage of composite resin and group III, thin coating (1-1.5) with composite resin coverage and group IV, ultrathin coating (0.5-1 mm) and group V, thin coating (1-1.5). The teeth were then thermally cycled for 1500 cycles (between 5 and 60 °C) and immersed in a dye for 24 hours. Leakage was measured as the degree of dye penetration. Concluded that the application of resin flow, even in ultrathin layer improved marginal sealing, reducing microleakage after thermocycling. This result is obtained by evaluating the different thicknesses of the fluid resin, which was not used in this study, where low shrinkage fluid resin remained the same results with a conventional technique composite. This difference was probably due to the smaller number of cycles of thermal cycling and the materials used.

According to Frankenberg *et al*., 2011[13], the flowing resin low shrinkage (bulk fill composite) designed to be used as basis for posterior restorations had the following advantages: single increment of up to 4 mm, without stratification (several layers), 60 % less polymerization shrinkage and 30-50 % reduction in procedure time compared with conventional composites, self-leveling consistency for optimum adaptation to the cavity (using conventional resins as base flow is no longer necessary) and compatible with current adhesive systems (resins and adhesives based on methacrylate). During curing, the technology employed in these resins allows the polymerization reaction occurs more slowly because of the presence of a modulating agent polymerization, leading to tension reduction without reducing the rate of polymerization. This results in a high rate of monomer conversion, in addition to reducing the possibility of postoperative sensitivity suggesting a better tooth-restoration interface in class II restorations in different thicknesses even when the same resin used in this study (SDR)[15].

Although not evaluated in this study, Fleming *et al*., 2012[5], concluded that the use of a flowable resin low shrinkage as a basis for class II restorations significantly reduced the deflection of the cusps of teeth premolars compared with restorations class type II using only conventional composite resin by the technique of gradual increase, important for postoperative sensitivity and dental cracks factor.

The fluid composite resins Low shrinkage stress (bulk fill composite) have four distinct characteristics: 1 - low polymerization shrinkage (decreasing the chances of leakage), 2 - polymerisation capacity of at least 4 mm (due to the material is translucent highly favorable and the transmission of light), 3 - fluid consistency (to permit easy drainage and cavity adjustment) and 4 - possess excellent physical properties such as good resistance to compression and wear[2].

However, Campos *et al*., 2002[16] evaluated through in vitro study the degree of marginal leakage with the use or not of flowable composite in class II cavities with gingival margins in dentin and concluded that the presence of resin used in the wall flow neck was unable to completely prevent the leakage nor soften it, however this category resin was not assessed in this study. Fleming *et al*., 2012[5] rated the degree of marginal leakage with the use or absence of fluid resin low shrinkage (bulk fill flowable) class II premolars type cavities and concluded that there was no significant difference in microleakage cervical, results corroborate the present study .

According Poggio *et al*., 2013[17], the composite resin restorations class II with margins below the cementoenamel junction, ie, dentin, evaluated with different techniques and restorative materials not completely eliminate microleakage.

The unanimous in the scientific literature that there is a variation between the substrate (enamel and dentin). The dentin to be more tissue rich in organic matrix promotes the adhesion smaller independent direct restorations system adhesive or restorative technique[18]. The results of this experiment are corroborated with studies in the literature showing that no material completely eliminates leakage in both enamel and dentin[8,16,17] compared the two structures, there is a greater infiltration dentin than to enamel in both groups due to structural and morphological diversity of these structures already known.

5. CONCLUSION

The use of flowable composite resin low shrinkage stress (bulk fill composite) obtained similar results of microleakage in class II cavities when compared with the conventional technique of restoration with composite resin.

The leakage was higher in dentin than in enamel.

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