# EVALUATION OF MICROLEAKAGE AT THE INTERFACE BETWEEN CAVITY WALLS AND GIOMER AND SILORANE BASED RESINS - IN VITRO STUDY

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## ABSTRACT

**INTRODUCTION: Despite of the significant improvement, methacrylate-based composites still exhibit polymerization stress forces, which could lead to damages in adhesion to tooth structures and microleakege, postoperative sensitivity and secondary caries. The aim of this study was to compare the microleakage at the interface between cavity walls and giomer and silorane-based composite material restorations.**

**MATERIAL AND METHODS: Eighteen extracted human teeth were used in this study. Two types of cavities were prepared on each tooth. The teeth were randomly assigned in two groups, each one with 9 teeth (18 cavities).**

**The first group was restored with the giomer Beautiful II and the second one with Filtec Silorane. The samples were subjected to 400 thermo cycles. The teeth were immersed in a 2% methylene blue buffered solution for 24 hours and rinsed under running tap water for 24 hours. They were hemi-sectioned longitudinally bucco-lingually through the center of the restoration and mycroleakage analysis was done.**

**RESULTS: None of the tested materials was without any microleakage. The average microleakage scores for the giomer were 0.72±0.83 (type I cavities - 1.00±0.87; type II cavities - 0.44±0.73) and for the silorane - 0.33±0.69 (type I cavities - 0.56±0.88; type II cavities - 0.11±0.3.3).**

**CONCLUSION: Based on the data obtained from the present study it can be concluded that silorane-based composite revealed less microleakage compared to the giomer. The cavities with smaller sizes revealed less microleakage as was expected in our null hypothesis.**

**Keywords:** *microleakage, silorane, giomer*

## INTRODUCTION

Adhesion to enamel has become routine and reliable from a few decades ago. Dentinal adhesion is still more difficult and less predictable due to the complex morphology and variable composition of dentine (1) and due to the occlusion forces. Failures in root caries restorations are often diagnosed, as their margins are mainly in dentin (2).

Despite of the significant improvement, the methacrylate-based composites still exhibit polymerization stress forces, which could lead to damages in adhesion to tooth structures and microleakege, postoperative sensitivity and secondary caries (3). This stress occurs when the organic resin matrix, consisting mainly of bisphenol-A glycidyl methacrylate (Bis-GMA) or urethane dimethacrylate (UDMA) polymerases, which leads to contraction, that often leaves tooth structures under constant stress. Polymerization stress can be reduced by a few restorative techniques (different layering methods), photoactivation protocols, with the increase of the proportions

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of inorganic filler and changes in the chemical structure (4,5).

Giomers are a new group of esthetic restorative materials, whose organic matrix is similar with the one of the traditional composites and consists mainly of Bis-GMA or UDMA, Their inorganic fillers are delivered from the complete or partial reaction of fluoroaluminosilicate glasses with polyalkenoic acids in water (6,7). There are two particle sizes – 10nm (nanoparticles) and 4μm. This allows higher saturation – 68.6 vol% to 83.3 vol% and leads to smaller polymerization shrinkage (8).

Another new class of esthetic restorative materials is the siloranes. Their matrix consists of ring-opening monomers, delivered from the reaction of oxirane and siloxane molecules. Thus during polymerization first they slightly enlarge their volume which compensation of the polymerization shrinkage, leading to volumetric shrinkage of 0.99 vol.% (9,10,11).

The **AIM** of this study was to compare the microleakage at the interface between cavity walls and giomer and silorane-based composite material restorations.

## MATERIALS AND METHODS

Eighteen extracted human teeth were used in this study. They were cleaned to remove all soft and hard tissues and stored in 1% chloramine solution. Two types of cavities were prepared on each tooth. Type one cavities (vestibular preparation) were with depth 2mm, medio-distal size 7mm and axial 4mm (Fig. 1). Type two cavities (lingual preparation) were with 1 mm depth, 1.5 mm axial size and 2mm medio-distal size (Fig. 2). The cavities were prepared using diamond burs medium-grit (Comet). A new bur was used for every four preparations. The cavities were situated at the cervical area, mainly in dentine, no more than thirty percent of the margins being in enamel. Thirty-six cavities were prepared, 18 type one and 18 type two. The teeth were randomly assigned in two groups, each one of nine teeth with18 cavities.

*Fig. 1. Type 1 cavity*

*Fig. 2. Type 2 cavity*

The first group was restored with the giomer Beautifil II (Shofu, Japan). It was used with the adhesive Beauty bond. The adhesive was applied to the cavity for 10 seconds, air dried for 3 sec. and light cured for 10s. For type one cavities the giomer was placed in the cavity in three equal increments first placed at the gingival area of the cavity, second one medially and third – distally, with depth no more than 2 mm and polymerized for 20 seconds. For type two cavities the restorative material was bulk filled.

The second group was restored with Filtec Silorane (3M ESPE). First was applied the primer and polymerized for 10 seconds, then the bond was applied, air dried and polymerized for 10 seconds. The silorane was placed with incremental technique (equal increments – same sequence as for the gi-


*Fig. 3. Sectioned teeth, ready for evaluation of the depth of microleakage*

*Fig. 4. Sectioned teeth, ready for evaluation of the depth of microleakage*

omer), for type one cavities and bulk filled for type two cavities.

The light-curing unit was Bluedent 3 halogen curing light (BG light LTD, Bulgaria), with soft start polymerization and a light intensity of 450mW/cm$^2$.

The specimens were stored in distilled water at 37°C for 48 hours. The teeth were covered with two layers of acid resistant varnish, except for 1mm width around the restorations. The samples were subjected to 400 thermo cycles between 5 and 55°C, with duration of 30 seconds for each one of the temperature intervals.

The teeth were immersed in a 2% methylene blue buffered solution for 24 hours and rinsed under running tap water for 24 hours. They were hemisectioned longitudinally bucco-lingually through the center of the restoration with a double-faced diamond disk. Two mirror halves were obtained for each restoration. All sections were subjected to microleakage analysis (Fig. 3, Fig. 4). The following scale was used: 0-no dye penetration, 1-dye penetration up to 1/2 of the cavity depth, 2-dye penetration deeper than 1/2 of the cavity depth, 3-dye penetration into axial wall of the cavity.

The significance of the results was assessed with descriptive analysis (measurements of central tendency: arithmetic mean, median; measurements of variation: variance, standard deviation, standard mean error), the hypotheses were checked with parametric (Student t-test for two independent samples, one-way analysis of variance (ANOVA) and non parametric (Mann-Whitney U tests, Chi-square criteria with Fisher's exact probabilities) methods. All calculations were performed by SPSS/PC v.13.0.

## RESULTS

The results are presented in Table 1. None of the tested materials was without any microleakage. No significant differences in microleakage scores were observed between the tested materials (p=0.191). No

*Table 1. Microleakage scores with mean values and standard deviation*

| | | I1 | I2 | I3 | M1 | M2 | M3 | P1 | P2 | P3 | Mean ± standard deviation. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Silorane | type 1 | 0 | 1 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0.56±0.88 | 0.33±0.69 |
| | type 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0.11±0.33 | |
| Giomer | type 1 | 1 | 2 | 0 | 0 | 1 | 2 | 1 | 0 | 2 | 1.00±0.87 | 0.72±0.83 |
| | type 2 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0.44±0.73 | |

*I – incisive; P – premolar; M – molar*

significant differences in microleakage were registered between type 1 and type 2 cavities (Table 2).

*Table 2. p-values for the mean values of microleakage for type one and type two cavities*

| | Type1 – Type 2 | |
|---|---|---|
| | t- test | p-value |
| Silorane | 1.414 | 0.176 |
| Giomer | 1.474 | 0.160 |

## DISCUSSION

Effective sealing of dentine is of significant importance for the durability of each restoration of esthetic material including new generations of dental materials. The most commonly used method for assessing the bonding quality of a restoration is microleakage. This study was undertaken with 2% methylene blue, because the size of its molecules is smaller than the diameter of dentinal tubules (1-4 µm) (12).

Incremental technique was used in order to minimize the curing shrinkage, by lowering the configuration factor (the ratio between the bonded and free surfaces of the cavity). The high values of this factor are associated with high stress on the adhesive surfaces and possible breakdowns of the bonding of the restoration to tooth structures (13).

Both tested materials had some degree of microleakage. Although no significant differences were observed, the mean values of the silorane microleakage were lower compared to the ones of the giomer. A possible reason can be the type of polymerization of silorane – ring opening, compared to the linear polymerization of the giomer, which is TEGDMA containing composite.

Authors who have found no statistically significant differences in microlekage scores of siloranes and methacrylate composites are Ernst et al. and Umer et al. (14,15). Both used hybrid composites. Ernst used an experimental adhesive, different from the two-component bonding system that was used in our study (14). Bogra et al. found out that silorane based composite exhibits significantly less microleakage (12). In this study the methacrylate-based composites contained organically modified ceramic nanoparticles and its filler loading was 76%, filler size of 0.1 µm. Since the filler volume of the used giomer was 83.3%, the absence of significant differences could be explained with lower contraction stress due to higher filler content. Krifka et al., Al-Boni et al. and Yancheva et al. also found lower microleakage scores for the silorane-based composite (16, 17, 18).

## CONCLUSION

Based on the data obtained from the present study it can be concluded that the restorations with silorane-based composite revealed less microleakage compared to the ones with the giomer. The cavities with smaller sizes revealed less microleakage as was expected in our null hypothesis.

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