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RESEARCH ARTICLE

The Comparison of Microleakage between Bioactive Composite Resin and Compomer

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ABSTRACT

Background: *The ideal restoration material should have endurance, compatible with tooth structure and visible surrounding tissues and must be able to restore the lost tissue. There are various restoration materials such as Compomer and Bioactive Composite Resin. Microleakage is one of the failure in surface sealent, and this may increase the risk of secondary caries.* ***Objective:*** *The aim of this study was to prove and compare the differences of microleakage between Compomer and Bioactive Composite Resin in class I restoration.* ***Methods:*** *Maxilla's first premolar teeth with class I cavities (diameter: 3mm, depth: 3mm) divided into two groups with 10 samples each group. Group I: Compomer (Dentsply), Group II: Bioactive Composite Resin (Activa Pulpdent USA). All group were immersed in 1% methylene blue solution for 24 hours, rinsed in running water, and section mesial-distal using carborundum disc. Afterward, section were assessed for dye penetration that represent the mickroleakage using scoring method under digital microscope. Finally data were collected and statistically analyzed.* ***Results:*** *There were significant differences between each group ($p<0.05$). Microleakage in restoration with Bioactive Composite Resin (1.7) shows smaller values than Compomer restoration (4.4).* ***Conclusion:*** *This research show that there is differentiation of microleakage between Compomer and Bioactive Composite Resin. In Bioactive Composite Resin found the smallest microleakage.*

Keywords: *Microleakage, compomer, bioactive composite resin*

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INTRODUCTION

Dental restoration materials are materials used to repair and restore the tooth structure biologically, aesthetically, and physiologically. Dental restoration materials not only have a good attachment between the restoration with the cavity walls but also have the protective properties to prevent secondary caries formation.[1,5]

A criteria of good marginal adaptation is is the absence of leakage at the border of the restoration and teeth.[1] Restoration microleakage is microscopic gaps between the cavity wall and the gaps that can be passed by microorganisms, fluids and molecules.[2] Microleakage can be caused by several factors, that are, shrinkage due to polymerization (polymerization shrinkage), the acidity of the oral cavity, thermal contraction, water absorption, mechanical stress.[3] Restoration is succeed if the restoration material and dental tissue can be attached properly. Adhesion of restorative material to dentin strongly affected by the polymerization reaction, the more perfect the polymerization, the material will have stronger attachment to dentin.[4] The presence of microleakage can trigger secondary caries, tooth discoloration, pulp sensitivity, and inflammation or the most extreme until the occurrence of pulp necrosis.[5]

Bioactive composite resin and the compomers are two dental restoration materials widely used nowadays and have many benefits, from the capability fluor releasing, physic value, and esthetic value.[3,6] Researchers want to compare the microleakage of the bioactive composite resin and the compomers. This study can provide information for clinicians to be able to use restoration materials with a low risk of microleakage and to know about the differences in microleakage of bioactive composite resin and compomers. Compomer is often used to restore primary teeth, but the failure rate is high enough to 27% so that the restoration is easily detached. From this statement, author wants to look for the solution.[5,10]

To reduce polymerization shrinkage, researchers in the field of dentistry have developed a composite resin with different matrix resin components. With the advancement of materials, a new restoration material was launched, combining bioactive ion resins with glass ionomer.[6] The aim is to combine the aesthetic properties of the composite resin and the ability to release fluoride ions as well as the adhesion properties of the glass ionomer. Another goal of bioactive composite resin material is to minimize the occurrence of micro-fissures, especially in pits and dental fissures. Bioactive was first introduced in 1969 and is defined as a material that can obtain a specific biological response to the surface of the material, then produces a bonding structure of the tooth with that material.[7] Bioactive composite resin has the ability to exchange more calcium, phosphate, and fluoride ions than GIC and stronger against stress. Bioactive composite resin has physical and aesthetic properties like a composite, this material can also stimulate the formation of apatite minerals and improve tooth structure to minimize the micro gap at the edge of the lift.[6]

Polyacid-modified resin-based composites or compomers were introduced as dental materials in the mid-1990s, was called compomers because it came from a combination of two materials that were"comp" from composite and "omer" from ionomer.[8] The combination of GIC with composite resin makes the compomers have the same adhesion ability as GIC and value as restoration as resin composite.[9] Compomers consist of Carboxylic acid-modified dimethacrylate (TCB resin), bisphenol a-dimethacrylate, urethane resin, triethylene glycol dimethacrylate (TEGDMA), and trimethylolpropane trimethacrylate (TMPTMA).[10] The formula of compomers is closer to composite resin, with the addition of the essential components of GIC that releasing fluorosilicate glass particle which can release fluoride is one of the advantages of compomers compared to conventional composite resin.[11]

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MATERIALS AND METHODS

This research was classified classified as true experimental laboratory research, using Randomized Post Test Only Control Group Design. This study used bioactive resin composite and compomers, each group contain 10 samples. The total sample is 20.

Twenty extracted premolars for orthodontic treatment were kept in normal saline, divided into 2 groups, each group contains 10 teeth. The teeth were prepared with 3 mm deep with a diameter of 3 mm was carried out. Then the teeth were washed using running water and dried with a chip blower. The teeth were divided into two groups of samples.

Group I (bioactive composite resin):

The entire surface of the cavity was etched with 37% phosphoric acid for 10 seconds, washed with distilled water, and dried by maintaining its moisture. Then the total-etch bonding was applied with a micro brush and irradiated for 10 seconds. The cavity was applied with a 3 mm deep bioactive composite resin with bulk technique, condensed with a stopper cement, then polymerized for 20 seconds.

Group II (compomer):

The entire surface of the cavity was etched with 37% phosphoric acid for 10 seconds, washed with distilled water, and dried by maintaining its moisture. Then the total-etch bonding was applied with a micro brush and polymerized for 10 seconds. The cavity was compressed with a 3 mm deep compomer by bulk technique, condensed with a cement stopper, then being cured for 20 seconds.

After all the sample teeth had been filled, the sample teeth were covered with red wax apically to prevent penetration of the solution, and the coronal section was coated with nail polish twice except at 1 mm around the restoration. Next, each sample group was put into a beaker and soaked in physiological saline solution, put in an incubator at 37ºC for 24 hours for the artificial aging process. The tooth removed from the incubator and dried. The sample soaked with 1% blue methylene solution for 24 hours at 37ºC.

After each group was treated, all sample teeth were washed and dried. The sample were fixated in the apical section, then carborundum disc was carefully directed in the middle of occlusal restoration. Tooth samples were cut in the buccopalatal direction to obtain mesial and distal cuts. Each part of prepared tooth was observed under digital microscope to see the penetration of 1% methylene blue for scoring. Penetration was seen in the coronal to apical direction along the axial wall to the cavity base.

The results of microleakage measurements of bioactive composite resin and compomers were analyzed using the Mann-Whitney U test with a confidence rate of 95% or at p = 0.05.

RESULTS

The results of the scoring measurements of two groups of research samples using a digital microscope regarding the extent of the microleakage of the bioactive composite resin obtained the following data:

Table 1. Microleakage's scoring result

	Group	Score				
		1	**2**	**3**	**4**	**5**
I.	**Bioactive**	4	5	1	0	0
II.	**Compomer**	0	0	1	4	5

From table 1, the score of microleakage of the bioactive composite spill is lower than that of the compomer.

The assessment method with scores is as follows:[12]

Score 1: no dye penetration
Score 2: dye penetration up to 1/3 cavity depth
Score 3: dye penetration up to 2/3 of cavity depth
Score 4: dye penetration until it reaches the entire axial wall
Score 5: dye penetration to cover the entire base of the cavity

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Table 2. Mean and standard deviation of microleakage

Kelompok	N	Mean	Standard Deviation
Bioactive	10	1,7	6,75
Compomer	10	4,4	6,69

From table 2, the average yield of microleakage of the bioactive composite spill is lower than the compomer.

DISCUSSION

This research was conducted to find out the differences in microleakage in the restoration material of bioactive composite resin and compomer. The results showed that teeth were restored using bioactive composite resins show less microleakage compared to teeth that were compressed using compomers. Bioactive composite resin restoration material shows better results because bioactive composite resin contains urethane dimethacrylate (UDGMA), does not contain bisphenol A, bis-GMA, BPA derivates and contains the main components in the form of bioactive ion resins, rubberized resins, bioactive glass ionomer, and silicate glass fillers. Crosslinking of methacrylate monomers when combined with self-cure initiators, which can polymerize lightly, self-cure stably, and efficiently during polymerization, will result in strong mechanical properties and good long-term stability.[13]

When polymerized, bioactive composite resin material bound by dental minerals forms strong complex hydroxyapatite resin bonds, so that the adhesion between the enamel and the restoration material is formed very well, and can minimize the occurrence of stress at the restoration interface and the teeth which have an impact on changing the vertical dimensions of the resin, and the possibility the formation of micro-fissures or leakage at the edge of the lift. Bioactive composite resins have a low depreciation value of 1.7 .[14]

Compomers experienced more microleakage compared to teeth which were restored using bioactive composite resins because compomer only can be polymerized with a light-curing unit. With the addition of the essential components of GIC, ion releasing fluorosilicate glass particles, which have the ability to release fluoride, is one of the advantages of the compomer.[15] The combination of GIC and composite resin makes the compomer have the same adhesion ability as GIC and has a good aesthetic value as restoration as in the case of composite resins.[9] However, besides having advantages, GIC has disadvantages such as high solubility and poor abrasion resistance. With high solubility, there will be a lot of material loss in the oral cavity.[16]

When curing the bioactive composite resin and the compomer, there is a change in the phase of the material from the gel form to a more rigid/solid form and undergoes a shrinkage process.[8, 15] When the material is applied to the preparation results and attached to the surface of the cavity, it is polymerized which will produce internal mechanical stress which is then passed on to the tooth structure attached to it. If the contraction power of a composite resin exceeds its bond with the tooth structure, debonding can be broken / loosening of the bond between the composite resin and the tooth. This can be one of the causes of microleakage, secondary caries, and fractures at the margins of the teeth.

During the polymerization process, the resin material will experience shrinkage.[17,18] Therefore, the resin material requires matrix and filler materials to reduce the shrinkage process. Clinically, to overcome this, acid etching and bonding techniques can also be used to obtain a better attachment between the resin restoration and the surface of the dental tissue.[19,20]

Some of the reasons mentioned above prove and describe the results of this study in accordance with the hypothesis that the formation of microleakage in enamel using bioactive composite resin material is lower than that of the compomer material, and with statistical results found a significant difference in the formation of microleakage produced between the materials bioactive composite resin

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and compomer to tooth enamel. These results are consistent with the other experiment who examined microleakage in bioactive composite resins compared to flowable composite resins. Thus, it is hoped that bioactive composite resins can be a choice of restoration material with a low risk of microleakage.[18,19, 20]

CONCLUSION

There are microleakages in compomer restorative materials and bioactive composite resins. Microleakage in bioactive resins is lower compared to compomers.

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