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Research Article

Differences of Microleakage Between Pit and Fissure Sealant Materials Composite Resin and RMGIC

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Abstract

The shape of deep and narrow pits and fissures can be a place of retention for both bacteria and debris and if this condition is left untreated, it can develop into caries. Effective efforts are needed to prevent caries, one of which is the application of pit and fissure sealants. Composite resin and resin-modified glass ionomer cement (RMGIC) are materials that are used as pit and fissure sealants. Consumption of drinks with an acidic pH, such as fermented milk, is one of the causes of microleakage because it degrades the sealant material. This study aims to know the differences in microleakage between pit and fissure sealant materials, composite resin, and RMGIC after immersion in fermented milk drinks. The sample of this research was divided into 2 groups, namely group A as composite resin and group B as RMGIC. Each group used a sample of 10 elements of the maxillary 1st premolar, then soaked in fermented milk drink for 6 hours at 37ºC, followed by immersion in 2% methylene blue for 4 hours, then penetration of 2% methylene blue was checked using the Beta 4.0.3 of Scion Image program. The average microleakage of group A was 0.761 mm, and that of group B was 2.178 mm. There were differences in microleakage from the pit and fissure sealant material composite resin, and RMGIC composite resin had lower microleakage rates than RMGIC materials.

Keywords: *pit* and *fissure sealant;* composite resin; RMGIC; microleakage; fermented milk drink

INTRODUCTION

Caries is a form of dental health disorder that affects the hard tissues of the teeth. Based on Riskesdas, in 2018, the percentage of caries in children aged 3-4 years reached 82%, which means that only 18% of children were caries-free, and in children aged 12, the percentage is 42.6% with a caries experience rate is 50.2%.[1] Occlusal surface is the most susceptible to caries and can be affected by variations in the shape and morphology of pits and fissures. The narrow and deep pits and fissures become good retention places for bacteria and food debris, and they are hard to clean and reach for saliva. If left unchecked, they can develop into caries.[2] Many efforts have been made for caries prevention, both primary, secondary, and tertiary.

Pit and fissure sealant is one form of primary prevention efforts with the aim of penetration and polymerization of the sealant material so pit and fissure closure occurs. Pit and fissure sealants should be used in the early stages of the eruption of premolars and molars because the child's ability to maintain dental hygiene is still limited, so these teeth are susceptible to caries before the maturation process is complete.[3] Mujiyati's research regarding the success rate of using fissure sealants shows that the effectiveness of pit and

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fissure sealants in preventing caries reaches 93.75%.

Composite resin and resin-modified glass ionomer cement (RMGIC) are materials that are commonly used as pit and fissure sealants. Composite resin is the choice because of its good mechanical properties, so it is suitable for teeth with large chewing loads. In RMGIC, the addition of HEMA gives it better mechanical properties, a longer working time, and a faster setting time.[4,5] The success of caries prevention from pit and fissure sealants depends on the resistance and ability of the material to cover the pit and fissure surfaces, especially the edge, because they are prone to leakage.[6]

Microleakage is a microscopic gap between the pit and fissure sealant material and the tooth surface, which can cause secondary caries, tooth discoloration, dentin hypersensitivity reaction, and accelerate sealant b reakdown.[7,8] Microleakage can also caused by the degradation of pit and fissure sealant materials due to beverages consumption with an acidic pH, such as fermented milk.[9] The acidic pH of fermented milk drinks can affect the pH of the saliva. According to Moeiny et al. (2017), salivary pH decreases after consuming a fermented milk drink for 2 minutes.[10] The 2018 top brands index data shows that Yakult is the most popular brand of fermented milk drinks, with an average consumption of 70%.

Based on the above, the authors are interested in conducting research related to the difference in edge leakage between composite resin sealant materials and resin-modified glass ionomer cement after immersion in fermented milk drinks.

MATERIALS AND METHODS

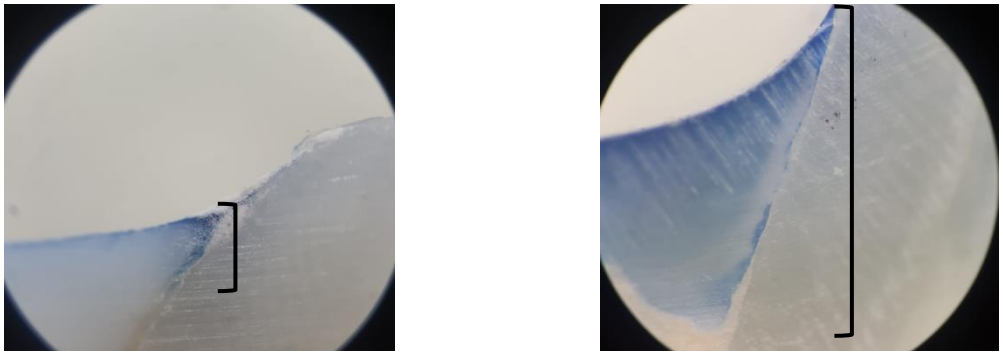
This laboratory experimental research was conducted at the Dental Conservation Clinic of the General Hospital and the Microbiology Laboratory of the Faculty of Dentistry, Jember University. The research sample consisted of 20 samples of maxillary 1st premolars and divided into two groups: ten dental elements applied by composite resin sealant (Group A/ Fissure Nova Plus) and ten dental elements applied by RMGIC sealant (Group B/ Nova Glass GL). The premolars used had clear pits and fissures, a 1 mm depth of pits and fissures, and no caries were examined visually or on sondation.

Elements of the maxillary 1st premolar have been implanted in the night beam. Then, it was cleaned using pumice with sterile distilled water. Then, apply pit and fissure sealant to the teeth that are ready to be etched using 37% phosphoric acid for 30 seconds, continue with bonding, and then cure for 20 seconds until the pit and fissure surfaces look shiny. Pit and fissure sealant materials were applied according to the treatment group.

After the application of the pit and fissure sealant, the dental elements were immersed in a fermented milk drink (Yakult) for 6 hours at 37^{o}C. The teeth were smeared with nail polish on the pit and fissure sealant with a distance of 1 mm and soaked in 75 ml of 2% methylene blue solution until all surfaces were soaked for 4 hours at 37^{o}C. Furthermore, the dental elements were cleaned and cut into 2 parts in the middle in a buco-palatal direction. 2% methylene blue penetration was observed using a stereo microscope with a magnification of 40x and measured using the Beta 4.0.3 of the Scion Image program with 3 repetitions. Take the average value from the data obtained. Then, the data was analyzed using an independent T-test to determine whether or not there was a difference between the treatment groups.

RESULT

The penetration of 2% methylene blue was examined using a stereo microscope with a magnification of 40x.



(a) (b)

Figure 1. Examination of microleakage using a stereo microscope, (a) Group A; (b) Group B

Table 1. Microleakage research results from both treatment groups (mm units)

Materials	Resin	RMGIC
Number of Samples	10	10
Mean	0.761	2.178
Standard Deviation	0.223	0.337

DISCUSSION

Based on the results of penetration of 2% methylene blue from the two treatment groups using Beta 4.0.3 of The Scion Image program, the composite resin has a smaller microleakage than RMGIC. Differences in microleakage may be due to the properties of pit and fissure sealant materials.

According to Dewi et al., in 2018, the microleakage of composite resin as pit and fissure sealant material was smaller than RMGIC due to the change in oral temperature. Each pit and fissure sealant material has a different coefficient of thermal expansion. The value of the thermal expansion coefficient of composite resin is $13.3x10^{-6}C$, RMGIC $15x10^{-6}C$, and enamel $11.4x10^{-6}C$. The difference in the value of this thermal expansion coefficient can affect the microleakage that occurs due to changes in temperature in the oral cavity.[4] The large difference in the coefficient of thermal expansion between the tooth structure and the pit and fissure sealant materials has an impact on the increase in microleakage that occurs.[11]

Based on the size of the filler material, the composite resin used is nanofill, while the type of resin-modified glass ionomer cement is not yet known. This is because there is no information or supporting research regarding the size of the filler material from this brand. The size of the filler material can influence the difference in edge leakage from composite resin pit and fissure sealants and resin-modified glass ionomer cement because the smaller the size of the filler material, the better its ability to reduce microleakage.[12]

The water absorption level of the resin-modified glass ionomer cement sealant material is greater than that of the composite resin material. This is due to the HEMA content in the resin-modified glass ionomer cement material, which is hydrophilic, which will increase the level of water absorption, plasticity, and hygroscopic expansion of the material. High levels of water absorption can affect the mechanical properties of the material and cause a decrease in the sealing ability of pit and fissure sealants. This decrease can cause the bond between the sealant material and the tooth surface to become weak and the matrix to easily degrade.[4,13] According to Purwanto (2012), the higher the adsorption rate of a material, the wider the surface area that will react with the liquid, so that the rate of degradation of the matrix increases.

Composite resin has a solubility value of 3.4 g/mm^3 while RMGIC is 4.4 g/mm^3.[4] The H+ ion from citric acid in

fermented milk can cause polymer chain breakage, which has an impact on the decomposition and dissolution of the matrix.[14,15] In previous research, it was proven that the release of unpolymerized components will increase in solutions with low pH. If the release of unpolymerized components is greater, the level of edge leakage will be greater. Differences in solubility values and increased dissolution of materials at acidic pH are among the factors causing the edge leakage rate of composite resin pit and fissure sealant materials to be smaller than resin-modified glass ionomer cement materials.[16] The difference in the solubility value and the increase of material release at acidic pH is one of the factors that cause the microleakage rate of the composite resin to be smaller than RMGIC.

CONCLUSION

There are differences in the level of microleakage between pit and fissure sealant composite resin and RMGIC due to fermented milk drinks. The composite resin has a lower microleakage rate than RMGIC.

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