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Research Report

Microleakage Difference of Self-Adhering Flowable Composite and Flowable Composite After Sitric Acid Immersion

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ABSTRACT

Background: *Flowable composite (FC) is a composite that has low viscosity so that it can flow to the cavity. Self-adhering flowable composite (SAC) is a type of flowable composite which is applied without the stages of etching and bonding because it has an acid monomer. Degradation in the oral cavity such as exposure to acidic fluid and changes in temperature can result in microleakage between the restoration and the cavity wall which can cause secondary caries, and hypersensitivity.* ***Purpose:*** *To prove the difference of microleakage between self-adhering flowable composite (SAC) and flowable composite (FC) after immersed in citric acid.* ***Methods:*** *28 bovine incisors were cleaned and soaked with 0.01% thymol then divided randomly into 4 groups, groups 1 and 2 are immersed in citric acid with SAC restoration and FC restoration. Groups 3 and 4 are SAC and FC material control groups. All groups were prepared class V with cylindrical shapes. Groups 1 and 2 were treated with thermocycling from 5^o and 55^{o}C for 120 cycles and immersed in 3364 ppm citric acid for 24 hours. All groups were immersed in 2% methylene blue for 24 hours, then buccolingual cut for 1 mm. Evaluation of microleakage was seen by the amount of color that entered between the restoration wall and the cavity using a 40x magnification Digital Microscope. Test data analysis using the Kruskal Wallis and Mann Whitney U.* ***Results:*** *Significant differences were found between SAC and FC. Significant differences were also obtained from SAC compared with the SAC control group. Whereas in the comparison between FC and FC control group no differences were found.* ***Conclusion****: Microleakage SAC is bigger than FC and SAC control group, but FC has no difference with FC control group.*

Keywords: *Microleakage; self-adhering flowable composite; flowable composite; citric acid*

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INTRODUCTION

Composite resin is one of the most commonly used materials in dental restorations because composites can replace tooth tissue with aesthetics and good function.[1] Composite resins can be used in Class I restoration to Class VI.[2] Composite resins can also be used as crown restorations, as adhesive bonding agents, pit and fissure sealants, endodontic sealants, bonding of ceramic veneers, cementation of crowns, bridges and other fixed prostheses.

Composite classification seen from manipulation characteristics can be divided into flowable composite and packable composite. Flowable composite has low viscosity, so that the resin can flow and spread easily, so it can adapt to the shape of the cavity and produce the desired dental anatomy. This will improve the ability of the clinician to form the base of the cavity or liner with good adaptation, especially effective in forms that have difficult access.[3] Flowable composite has several advantages, namely the simple and aesthetic way of placement. The disadvantage of flowable composite is the high incidence of secondary caries and sensitivity.[4]

Conventional flowable composite (FC) has no adhesive properties, so the use of etching and bonding needs to be done.[5] Self-adhering flowable composite (SAC) is one of the newest commercially available restoration materials that has been developed to reduce treatment chairside time by simplifying procedures restorative. This new development in the field of adhesive materials aims to improve the effectiveness of care with an economy of time and cost.[cr6]

SAC eliminates etching, priming and bonding procedures so that it has a lower failure rate than FC, because fewer errors are associated with technical procedures.[5] The durability of restoration is needed so that the composite can be used for a long time. Factors that can affect the resistance of restorations include the patient, the operator, the material, and the factors of the tooth. Operator factors are experience and skills that meet technical procedures. The material factor is the adhesive system, and the tooth factor is the classification of the restoration cavity and the type of tooth. [7]

The long-term use of a restoration depends on the type of restoration and the resistance of a restoration to degradation. Degradation in the oral zone is a complex phenomenon associated with disintegration and dissolution of the restoration material in the oral cavity. Composite resins get drastic changes from the physical and chemical conditions in the oral cavity such as changes in temperature, differences in compressive forces, chewing power and chemical conditions of food consumed. These factors will have an impact on the degradation and failure of composite restorations. [8] The degradation process can affect the mechanical properties of the restoration, such as durability, bond strength, integrity between teeth and restoration, aesthetics, hardness and surface roughness. [9,10]

One important function of dental restoration is to seal the exposed dentine so that it can prevent pulp damage and secondary caries. If there is a microleakage between the restoration and the teeth, acid ions from the erosion material can enter the gap. This will cause secondary caries to reach the dentine and cause cavity hypersensitivity. Clinically there will be discoloration in composite resins, bad attachments to the teeth, cracks in the resin and others.[11,12]

Degradation of composite resins can also be in the form of material loss due to erosion. Tooth erosion is loss of tooth hard tissue due to chemical processes caused by non-bacteria.[13] The edges of the restoration can be damaged after the erosion process and can result in microleakage because the degree of compatibility between restorations and dental tissue is an important factor in microleakage. Other factors that cause erosion are lifestyle, such as consumption of acidic foods, alcoholic beverages, soft drinks and energy drinks.[11,12]

In the last two decades, consumption of energy drinks has increased rapidly, and found an increase in sales of 56% from 2002 to 2006, especially among teenagers and young adults.[14] Energy drinks are drinks that can improve performance and endurance. To strengthen the taste, some energy drinks are added to citric acid.[15] From a study it has been shown that citric acid in orange juice has more impact on restoration compared to phosphoric acid in coca cola. [16]

MATERIALS AND METHODS

This type of research is an in vitro posttest-only control group design laboratory experimental study. 28 bovine incisors were cleaned and soaked with 0.01% thymol then divided randomly into 4 groups. Groups 1 and 2, namely the group given immersion of citric acid with SAC (Dyad Flow, Kerr) restoration and FC restoration (3M ESPE). Groups 3 and 4 are groups without soaking citric acid in the restoration with SAC and FC ingredients. All groups were prepared class V with cylindrical shapes. Groups 1 and 2 were given thermocycling treatments at a temperature of 5^o and 55^o C for 120 cycles and soaking citric acid 3364 ppm for 24 hours. All groups were immersed in 2% methylene blue for 24 hours, then buccolingual cut 1 mm thick. Evaluation of microleakage was seen by the amount of color that entered between the restoration wall and the cavity using a 40x magnification Digital Microscope. Test data analysis using the Kruskal Wallis and Mann Whitney U.

RESULTS

This study has a sample consisting of 4 groups. Groups 1 and 2 are samples that are immersed in citric acid. Group 1 uses SAC and group 2 using FC restorative material. Groups 3 and 4 were untreated control groups. Group 3 uses SAC and group 4 uses FC. The mean of the microleakage score is shown in Table 1.

The data obtained are ordinal non-parametric data so that the Kruskal Wallis test is used to find out whether there are significant differences in this study. The testing criteria is if the value of $p < 0.05$, the data is assumed to have a significant difference. From the analysis of the data shows that p 0.005 which indicates that the results of this study have significant differences from all groups.

The research data then carried out a significance test to see significant differences between groups one with the

Table 1. Average values and standard deviations of the four sample groups

Group	N	Average	Standard Deviation
I (self-adhering flowable composite with citric acid immersion)	7	2.1429	± 0.69007
II (flowable composite with citric acid immersion)	7	0.2857	± 0.48795
III (control: self-adhering flowable composite)	7	1.0000	± 0.81650
IV (control: flowable composite)	7	0.7143	± 0.95119

Table 2. Value of p between sample groups

Group	1	2	3	4
1	-	0.002 *	0.022*	0.015*
2	0.002 *	-	0.080	0.409
3	0.022 *	0.080	-	0.496
4	0.015 *	0.409	0.496	-

Information: * = there are significant differences

Table 3. Molecular weight of composite substances

Substantion		Molecul weight
Bis-GMA	Bisphenol-A-glycidyldimethacrylate	512
Bis-EMA	Epoxylated bisphenol A-dimethacrylate	452
UDMA	1,6-bis(methacrylyloxy-2-ethoxycarbonylamino)-2,4,4-trimethyl-hexane	470
HEMA	2-hyroxyethylmethacrylate	130

other groups using the Mann Whitney U test. From the Mann Whitney U test group 1 had a significant difference to group 2, group 3, and group 4. The form of p values was respectively each of which is 0.002, 0.022 and 0.015.

Group 2 was compared with group 3, and group 2 compared to group 4 did not have a difference with a p value of 0.080 and 0.409. Group 3 compared to group 4 did not have a significant difference with a value of p 0.400. The data in Table 2 shows the p value of the sample groups. Followed by Table 3 shows the Molecular weight of composite substances.

DISCUSSION

Microleakage in this study was seen from the scoring of the color from dye that entered between the slit of the restoration and the cavity wall. Samples are cut buccolingually in parts with the largest diameter. This piece has a slight disadvantage, which we can only see the occlusal wall and the gingival wall, unable to see the microleakage from the entire wall of the cavity.

The results of this study were found to be significant differences between microleakage self-adhering flowable composite with flowable composite after immersion of citric acid. However, the results obtained were not in accordance with the hypothesis that the average microleakage self-adhering flowable composite score after being given citric acid immersion in the form of 2.1429 was greater than the average flowable composite microleakage score after being given immersion of citric acid in the form of 0.2857.

One of the factors that cause microleakage is due to the molecular weight of the matrix (Table 3). Greater molecular weight will result in smaller polymerization shrinkage.[17] Because when polymerizing, when monomers are converted into polymers, there is shrinkage in free volume due to changes in the bond chain length from monomers to polymers.[18] In larger molecular weight monomers, there is less free volume so that the final polymerization shrinkage becomes smaller. [19]. Self-adhering flowable composite used in this study contains HEMA matrix while flowable composite used contains bisGMA, UDMA, bisEMA matrices. In conclusion, microleakage SAC is bigger than FC and SAC control group, but FC has no difference with FC control group.

REFERENCES

1. Cramer, NB, Stansbury, JW, Bowman, CN 2011, ‘Recent Advances and Developments in Composite Dental Restorative Materials’, Journal of Dental Research, vol. 90, no. 4, pp. 402.
2. Eakle, WS & Hatrick, CD 2015, Dental Materials: Clinical Application for Dental Hygienists, 3rd Edition, Elsevier Health Sciences Saunders, Santa Rosa.
3. Anusavice, K, Shen, C & Rawls, H 2013, Phillips’ Science of Dental Material ed12, St. Louis, Mo, Elsevier Saunder, pp. 275-306.
4. O’Brien, WJ 2002, Dental Materials and Their Selection, Edition 3rd, Quintessence Publishing Co, Inc.
5. Tuloglu, N, Tunc, ES, Ozer, S & Bayrak, S 2014, ‘Shear bonf strength of self-adhering flowable composite on dentin with and without application of an adhesive system’, Journal of applied Biomaterial Funct Mater, pp. 97-101
6. Miletic, V 2018, Dental Composite Materials for Direct Restorations, University of Belgrade School of Dental Medicine Belgrade, Serbia, pp. 129-54.
7. Kubo, S, Kawasaki, A & Yoshihiko Hayashi 2011, ‘Factors Associated with the Longevity if Resin Composite Restorations’, Dental Material Journal, vol. 30, no. 3, pp. 43-55.
8. Khan, AA, Siddiqui, AZ &Al-kheraif, AA 2015, ‘Effect of different pH solvents on micro-hardness and surface topography of dental nano-composite: An in vitro analysis’, Pak J Med Sci, vol. 31, no. 4, pp 31, 854-9.
9. Rios D, Honório, HM, Francisconi, LF, Magalhães, AC, de Andrade, MMMA & Buzalaf, MA 2008, ‘In situ effect of an erosive challenge on different restorative materials and on enamel adjacent to these materials’, Journal of Dentistry, vol. 36, pp. 152- 7.
10. Da Silva, MA, Vitti, RP, Sinhoreti, MAC, Consani, RLX, Silva-Junior, JG & Tonholo, J 2016, ‘Effect of Alcoholic Beverages on Surface Roughness and Microhardness of Dental Composites’, Dental Material Journal, vol. 35, no.4, pp. 621-626.
11. Adioro, S 2013, Penggunaan Resin Komposit dalam Bidang Konservasi Gigi, PT. Revka Petra Media, Surabaya, pp. 45-47.
12. Sabdi, S, Zaripah, W, Bakar, W & Husein, A 2011, ‘Assessment of microleakage of few restorative materials after erosion by acidic solution’, Archives of Orofacial Science, vol. 6, pp 6, 66–72.
13. Afonso, M, Buzalaf, R., Hannas, AR & Kato, MT 2012, ‘Saliva and dental erosion’, Journal of Applied Oral Science, vol. 20, no. 5, pp. 493–502.
14. Alsunni, AA 2015, ‘Energy Drink Consumption: Beneficial and Adverse Health Effects’, International Journal of Health Science, vol. 9, no. 4, pp. 468–474.
15. Nesli, A, Selen, T, Gulgun, E, 2010, ‘Sports and energy drink consumption of physical education & sports student and their knowledge about them’, Turk: J Ovidius Uni, no. 2, pp. 732-6.
16. Han, L, Okamoto, M, Fukushima, M. & Okiji, T 2008, ‘Evaluation of Flowable Resin Composite Surfaces Eroded by Acidic and Alcoholic Drinks’, Dental Materials Journal,

vol. 27, no. 3, pp. 455-65.
17. Soares, CJ, Faria-e-silva, AL, Rodrigues, MP, Vilela, ABF, Pfeifer, CS, Tantbirojn, D & Versluis, A 2017, 'Polymerization shrinkage stress of composite resins and resin cements – What do we need to know?', Brazilian Oral Research, vol. 31, no. 1, p. 2.
18. Sakaguchi & Powers 2012, Craig's Restorative Dental Materials, Elsevier/Mosby, St. Louis, pp. 161-75.
19. Ozel Bektas, O, Eren, D, Akin, EG, Akin, H 2013, 'Evaluation of a self-Adhering flowable composite in terms of micro-shear bond strength and microleakage', Acta Odontologica Scandinavica, vol. 71, no.3-4, pp. 541-6.
20. Rahimian-imam, S, Ramazani, N & Fayazi, MR 2015, 'Marginal Microleakage of Conventional Fissure Sealants and Self-Adhering Flowable Composite as Fissure Sealant in Permanent Teeth', Journal of Dentistry: Tehran University of Medical Science, vol. 12, no. 6, pp. 430–5.
21. Casselli, DSM, Faria-e-silva, AL, Casselli, H & Martins, LRM 2013, 'Marginal adaptation of class V composite restorations submitted to thermal and mechanical cycling', Journal of Applied Oral Science, vol. 21, no. 1, pp. 68-73.
22. Rosales-leal, J.I, María, C, González-moreira, H & Cabrerizo-vílchez, MA 2013, 'Effect of Hygroscopic Expansion of Resin Filling on Interfacial Gap and Sealing : A Confocal Microscopy Study', Journal of Adhesive Dentistry, vol. 15, no. 5, pp. 423–30.
23. Wei, YJ, Silikas, N, Zhang, ZT, & Watts, DC 2011, 'Hygroscopic dimensional changes of self-adhering and new resin-matrix composites during water sorption/desorption cycles', Dent Mater, vol. 27, pp. 259–66.
24. Wei, YJ, Silikas, N, Zhang, ZT, & Watts, DC 2011, 'Diffusion and concurrent solubility of self-adhering and new resin-matrix composites during water sorption/desorption cycles', Dent Mater, vol. 27, pp. 197–205.
25. Amaechi, BT 2015, Dental erosion and its clinical management, Springer, London, pp. 70, 100-10.