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THE EFFECT OF 0.12% CHLORHEXIDINE DIGLUCONATE AND 0.1% CHLORINE DIOXIDE ON DISCOLORATION OF NANOFILLED COMPOSITE RESIN

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ABSTRACT

Background: Composite resins are able to generate the color of dental restorative materials based on the original teeth's color. Nanofilled composite resins have compressive strength, good polishing, and color stability compared to other types of composite resins. Color changes may occur due to intrinsic and extrinsic factor example mouthwash. Mouthwash that is commonly used is chlorhexidine. In the previous study, the use of chlorhexidine mouthwash continuously may stain the composite resins. Mouthwash that has a good anti-plaque other than chlorhexidine is chlorine dioxide which has a clear color and does not cause changes in taste on the tongue. **Aim:** To determine the effect of 0.12% chlorhexidine digluconate mouthwash and 0.1% chlorine dioxide mouthwash to the discoloration of nanofilled composite resins. **Methods:** This study is an experimental study with a pre-test and post-test control group design. Samples are nanofilled composite resins made into discs in total of 27 and divided into three groups with different treatments, soaked with 0.12% chlorhexidine digluconate mouthwash, 0.1% chlorine dioxide mouthwash, and sterile distilled water. Each group was soaked for 24 hours and tested for staining using chromameter. **Result:** ANOVA test showed the significant difference between group, that the greatest color change is the one soaked with 0.12% chlorhexidine digluconate mouthwash compared to 0.1% chlorine dioxide mouthwash. **Conclusions:** The use of 0.1% chlorine dioxide mouthwash does not cause discoloration as much as 0.12% chlorhexidine digluconate mouthwash.

Keywords**:** *Chlorhexidine digluconate, Chlorine dioxide, nanofilled composite resin, discoloration*

INTRODUCTION

The development of science which is rapidly increasing influences the development of dental restorative materials, one of which is composite resin. Composite resins have evolved with the aim not only to improve physical, mechanical but aesthetic characteristics.[1] The aesthetic restoration material requirements must be in accordance with the original teeth in color, transparency, and texture. Composite resins can produce the color of dental restorative materials according to the color of the original teeth.[2]

Composite resins have the property of easily absorbing liquids so they can cause discoloration.[3] Color changes can occur due to intrinsic and extrinsic factors. Extrinsic color changes can occur due to water absorption and contamination due to adsorption of dyes from exogenous sources such as soft drinks, coffee, tea, fermented milk, red wine, nicotine and mouthwash. Changes in color of composite resin restorations, especially in the anterior teeth aesthetically cause complaints in patients.[4-6]

The use of mouthwash as a control for caries, halitosis and periodontal disease in recent years has increased. The use of mouthwash can prevent caries and periodontal disease, but the use of mouthwash can also cause damage to tooth restoration.[7] Chlorhexidine is an ingredient in mouthwash with good anti-microbial power to reduce plaque.[8] Chlorhexidine used continuously has several deficiencies that is, it can reduce the sensitivity of the sense of taste and discoloration of the mucosa, dorsum of the tongue, teeth and composite resin. The alcohol content of chlorhexidine mouthwash has a major effect on discoloration of the composite resin.[9-11] Mouthwash containing chlorhexidine on the market are in the form of chlorhexidine gluconate 0.2%, 0.12% and 0.1% also 0.12% chlorhexidine digluconate.[16] The content of mouthwash other than chlorhexidine is povidone iodine, fluoride, herbs and chlorine dioxide.[12]

Chlorine dioxide is an oxygen oxidizing agent that can be used as an antiseptic in wounds and accelerates healing and is effective for gingivitis, periodontitis, bleeding gums and especially for halitosis.[8] The difference in the use of mouthwash between those containing chlorhexidine and mouthwash containing chlorine dioxide is mouthwash containing chlorine dioxide in long-term use does not cause changes in taste taste on the tongue.[13]

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Based on this, a study was made to find out better mouthwash content between 0.12% chlorhexidine digluconate and 0.1% chlorine dioxide on the color stability of nanofil composite resins. There are no studies that have examined the effect of mouthwash containing 0.12% chlorhexidine digluconate and 0.1% chlorine dioxide on the discoloration of nanofil composite resins.

MATERIAL AND METHODS

Study design

This research is a pure experimental study (true experimental) with a pre-test and post-test control group design research design using nanofil composite resin as a sample. The selection of subjects into a treatment or control group is done randomly. which has held at the Laboratory of Food Science, Faculty of Agricultural Technology, Soegijapranata University, Semarang and the Dental Laboratory of the Faculty of Medicine, Diponegoro University, Semarang, from December 2019 to January 2020.

Materials

The material in this study uses nanofil composite resin, 0.12% chlorhexidine digluconate mouthwash, 0.1% chlorine dioxide, and sterile distilled water. The tools in this study used cylindrical molds of 10mm x 2mm acrylic material, plastic instruments, light curing, sample immersion, micromotor, handpiece, finishing bur, polishing bur, chroma meter, incubator, pH meter.

Methods

Samples using nanofil composite resins which are printed using acrylic molds and light curing for 20 seconds and polished for 1 minute. Samples coated with nail polish on the unpolished side were then divided into 3 immersion groups on 0.12% chlorhexidine digluconate mouthwash, 0.1% chlorine dioxide, and sterile distilled water. Samples were placed in immersion sites that were filled with 5 ml of artificial saliva and incubated for 24 hours. After 24 hours the color test was done using a chroma meter and then put back to the place where the samples were filled with mouthwash and sterile distilled water. The samples were retested using chroma meter after incubation for 24 hours.

Statistical analysis

Data obtained from research uji normality using Shapiro-Wilk is done to determine the normal distribution of data from the three groups and homogeneity test with the Levenne's Test to determine the homogeneity of variance. If the data shows a normal and homogeneous distribution, then the analysis of the data used is the one-way ANAVA test with a confidence level of 95% ($\alpha = 0.05$) . If the ANAVA test results show one path the difference, then continued with the post hoc test using the Least Significant Difference (LSD) test. If the data are not normal, then the Kruskal Wallis non-parametric test is continued with the Mann Whitney test. There is a significant difference when $p < 0.05$.

Ethical appearance

Research is free from ethical clearance because samples are not from human objects or experimental animals.

RESULT

The discoloration test using a chroma meter, while the color change is calculated using the color change formula (ΔE). From the calculation results obtained the average value of color changes in nanofil composite resins as in Table 1.

Table 1 Mean and standard deviation (SD) of discoloration of nanofil composite resins

Group	Amount Group	Mean ± SD
Group I Chlorhexidine digluconate 0.12%	9	4.52 ± 0.97
Group II Chlorine dioxide 0.1%	9	2.42 ± 0.56
Control group Sterile distilled water	9	0.92 ± 0.46

The results of the normality test using Saphiro-Wilk in group 1 have a significance value of 0.120 (p> 0.05), group 2 has a value of 0.398 (p> 0.05), and group 3 is 0.085 (p> 0.05) so that the overall treatment group shows a normal data distribution. Homogeneity Test*Levene* shows a significance value

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of 0.060 (p> 0.05) so that it can be concluded that the existing data has a homogeneity of variance between groups. Data were then analyzed using the one-way ANAVA test.

Table 2 ANAVA test results in a single path change color nanofil composite resin

Source of Variation	Number of squares	Free Degrees	Average of squares	F	*p*
Between groups	58,631	2	29,316	59,439	0,000 *)
In Group	11,837	24	.493		
Total	70,468	26			

*significant differences(p <0.05)

Table 2 shows the significant differences between treatment groups (p<0.05). To find out which groups produce color changes Significantly different between the three treatment groups was performed post hoc test using the Least Significant Difference (LSD) test.

Table 3 Comparison of the antibacterial effect of fluoride toothpaste with positive control and negative control

Group	Group	*p*
P 1	P 2	0,000 *)
	K	0,000 *)
P 2	P 1	0,000 *)
	K	0,000 *)
K	P 1	0,000 *)
	P 2	0,000 *)

* significant difference (p <0.05)

Table 3 shows that between all treatment groups resulted in significant changes in the color of nanofil composite resin.

DISCUSSION

The aim of this study was to examine the effect of 0.12% chlorhexidine digluconate mouthwash and 0.1% chlorine dioxide on the change in color of the nanofil composite resin. Before treatment, mouthwash was measured by pH and the result was 0.12% chlorhexidine digluconate pH was 6.9 and chlorine dioxide pH 0.1% was 7.2. Each mouthwash has different degrees of acidity (pH). The nanofil composite resin as a sample was immersed with 0.12% chlorhexidine digluconate mouthwash as P1 group, 0.1% chlorine dioxide as P2 group, and sterile distilled water as control group K.

Color changes that occur in composite resins are related to the water absorption properties possessed by composite resins. Composite resins have the ability to absorb fluids which can cause color changes.[14,15] Color changes can be caused by extrinsic and intrinsic factors. Extrinsic factors such as soft drinks, coffee, tea, fermented milk, red wine, nicotine, and mouthwash.[16,17] In this study mouthwash was used with the type of chlorhexidine digluconate 0.12% and chlorine dioxide 0.1% and sterile distilled water as control. The immersion of nanofil composite resins in this study showed that the biggest color change was in the immersion group with 0.12% chlorhexidine digluconate mouthwash and the smallest color change was in immersion with sterile distilled water.

0.12% chlorhexidine digluconate seeped into the composite resin and degraded siloxane bonds through hydrolysis reactions and began to weaken the filler bonds at the resin matrix interface so that water is easily absorbed into the resin causing color changes.[18,19] This is in line with the study of Widyastuti, et al. which states that chlorhexidine mouthwash has active substances and coloring agents which can make staining on composite resins.[2]

The results of soaking in 0.1% chlorine dioxide mouthwash show a slight change in color. The difference in color changes that occur is probably caused by differences in the percentage of active substances, pH differences, and differences in the color of mouthwash solution used in the study. Chlorine dioxide mouthwash has a smaller concentration of active substance that is 0.1% and has a pH that tends to be alkaline which is 7.2 and the color of clear clear solution. High concentrations

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of active substances can make discoloration of teeth and composite resin.[20]

Situations where acidic or low pH can stain the composite resin by softening the matrix in the resin and degradation polymeric bonds so that some of the monomers from the resin break away. The release of this filler will cause more empty spaces between the polymer matrices, making it easier to process the diffusion of liquid from the outside into the resin. Thus a liquid containing a dye such as 0.12% chlorhexidine digluconate mouthwash which is pink can enter the empty space between the matrices. This causes the treatment group to have a greater ΔE than the control group. Some residual monomers from the resin will break away accompanied by the release of nano filler material on the surface of the composite resin.[6,15,20]

CONCLUSION

Based on the results of the study, it can be concluded that there are color changes in the nanofil composite resin soaked with mouthwash 0.12% chlorhexidine digluconate and 0.1% chlorine dioxide. And 0.1% chlorine dioxide mouthwash gives a smaller color change effect on nanofil composite resin compared to 0.12% chlorhexidine digluconate mouthwash and is greater than sterile distilled water.

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