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COMPARISON OF COLOR CHANGE IN GLASS IONOMER CEMENT (GIC) AFTER TOPICAL FLUORIDE APPLICATION

Using Type II Conventional GIC and Topical Fluoride in Sodium Fluoride (NaF) and Acidulated Phosphate Fluoride (APF) Preparations

Muhammad Yanuar Ichrom Nahzi, Isyana Erlita, A.M. Dewi Fathiya Julianti
Dentistry Study Program, Faculty of Dentistry, Lambung Mangkurat University

ABSTRACK

Background : *Conventional glass ionomer cement is an applicative material used in dentistry. Topical flouride is widely used as a preventive measure against caries; it is available in various forms, such as Sodium Flouride (NaF), Stannous Flouride (SnF_2), and Acidulated Phosphate Flouride (APF). There are a few considerations in selecting which form to use, and one of them is the physical characteristic which may interact and change the color of previously placed conventional glass ionomer cement.* ***Purpose :*** *This study aimed to find out whether there was a difference of color change in conventional glass ionomer cement after topical fluoride application between NaF and APF form.* ***Method :*** *This study was a true experimental research using pre and posttest with control group design. There were 18 samples divided into 2 treatment groups and 1 control group. Each group had 6 samples. The measurement was carried out using optical spectrometer (OPT 101 type of photo detector) and microvolt digital.* ***Result****: The mean color change in conventional glass ionomer cement after APF and NaF topical application was 1,7300 mv and 0,4983 mv respectively. One way ANOVA test and post hoc LSD test results showed a significant difference ($p<0.05$).* ***Conclusion :*** *Discoloration on APF topical application was higher than NaF.*

Keywords : *Acidulated Phosphate Fluoride (APF), discoloration of conventional glass ionomer cement, Sodium Fluoride (NaF), topical fluoride.*

Correspondence : Muhammad Yanuar Ichrom Nahzi, Faculty of Dentistry, Lambung Mangkurat University, Jl.Veteran 128 B, Banjarmasin, South Borneo, Indonesia., email: ichromnahzi@yahoo.com

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INTRODUCTION

Technology advancement has gained a positive effect for dental restorative materials, which continuously improve in many aspects, such as aesthetics, hardness and strength to withstand masticatory forces, and its more refined adhesion to tooth structure. Widely used material in clinical dentistry to restore either deciduous or permanent teeth is tooth-colored adhesive material. Tooth-colored restorative material most-commercially distributed is conventional glass ionomer cement (GIC), compomer, and composite resin.[1] This material excels when used to treat paediatric patient with high caries risk because of its ability to release fluoride, acceptable aesthetic, and can also be used to treat class III and V cavity in adult patients.[2] Fluoride release from glass ionomer cement works as antimicrobial and cariostatic agent, and helps enamel remineralisation and prevents caries.[1]

Fluoride is commonly used as a preventive measure against caries, and it can be delivered systemically or topically. Systemically, fluoride can be given as fluoride tablets or through drinking-water fluoridisation. Topically, a fluoride gel preparation is available to be applied on tooth surface or using special mouth trays, and there is also fluoride-containing mouth rinse.[3,4]

Fluoride topical application on tooth surface gives local protection effect and isn't for consumption.[5] Topical preparations of fluoride are available in various forms, such as Sodium Fluoride (NaF), Stannous Fluoride (SnF_2), and Acidulated Phosphate Fluoride (APF). In each form, there are

different standardized concentrations. NaF is recommended in a 2% concentration, made by mixing 0,2 grams powder with 10 ml distilled water. [6] Recommended concentration for SnF_2 is 8%, made by mixing 0,8 grams of SnF_2 powder with 10 ml distilled water. This solution is a bit acidic, with pH of 2,4-2,88. APF is available in solution and ready-to-use gel, and is one of the most commercial materials and freely distributed. APF gel usually has flavours added, such as orange, grapes, and limes.[7] APF gel contains approximately 12,3 mg ion F/gm gel or 12,300 ppm fluoride ions with pH of 3,5.[8]

Topical fluoride gel application visit is scheduled according to patient's needs; for patient with active caries, gel can be applied four times during two to four weeks. Application time each visit for this type of patient is four minutes. After fluoride application, patient is instructed not to eat, drink, or rinse their mouth for 30 minutes.[9]

Fluoride is effective in caries prevention, depending on the concentration used, the frequency of application, the duration, and which fluoride component is used.[9] But there are side effects to this treatment, one of them is the color change of tooth if the concentration used is excessive or if the frequency of application is too many.[10] According to Eric Wang (2014), fluoride topical application on restorative material glass ionomer cement, in different concentrations, could cause color change. The higher the fluoride concentration was, the higher the effect of color change was, and this could decrease the value of aesthetics.[11] This study aimed at finding out the color change in conventional glass ionomer after NaF and APF topical application.

MATERIALS AND METHODS

This research was true experimental with pretest and posttest with control group design. Samples were chosen using simple random sampling and divided into 3 groups of sterile aquadest as control group, NaF and APF treatment groups. Conventional glass ionomer cement samples used were shaped as cylinder with diameter of 15mm and thickness of 1 mm. Number of samples was counted using Lemeshow equation and the result showed that there should be 6 samples in each group, which meant 18 samples in total. Measurement of color change was carried out at Laboratorium Optik dan Aplikasi Laser Departemen Fisika, Universitas Airlangga.

Specimens were made by following the characteristics explained previously using a mold; conventional glass ionomer cement was mixed according to its written instruction with ratio of powder : liquid 1:1 and carefully placed into the mold. To keep the surface flat and smooth, a celluloid strip was placed on it and flattened by a thin glass. After initial setting, celluloid strip was lifted and specimen was taken out from the mold, and then put in a cylindrical glass (petri dish) and stored in a 37^o incubator for 24 hours to reach final setting in maximum condition.

To get a 2% NaF solution, 0,2 grams NaF powder was mixed in 10 ml distilled water until it became homogenous. This solution was then applied on a brush and the brush was used to lather the surface of the specimen for 4 minutes. The same procedure was used for the application of APF gel and sterile aquadest. Samples were then place on absorbable paper for 1 hour in normal room temperature and then they were rinsed under flowing water for 30 seconds. The treatment procedure was then repeated once more. Then the samples were put back into the incubator and the measurement was done after 24 hours post-application.[11]

The measurement of color change in conventional glass ionomer cement was carried out using optical spectrometer (OPT 101 type of photo detector) and microvolt digital.[12] The procedure was done by placing He-Ne laser light source, OPT 101 type photo detector, samples and microvolt digital on the research table. He-Ne laser and OPT 101 type photo detector were directed to be in one straight line. Photo detector was connected to microvolt digital to read the tension coming from photo detector. Photo detector would change the intensity value into tension. Samples were then put on their respective place which then would be lighted by He-Ne laser light until an interval value in microvolt digital appeared and did not change.[13]

Data collected from this research were from the observation of difference count in color change measurement of conventional glass ionomer cement before and after NaF and APF topical application. After that the surface of the specimens was measured using OPT 101 type of photo detector and microvolt digital.

Data was then evaluated statistically by using Shapiro-Wilk normality test and Levene's homogeneity test. If the data was distributed normally and homogenous, it would be evaluated using one way ANOVA parametric test with 95% significance value ($\alpha = 0,05$) followed by Post Hoc LSD test.

RESULTS

Results of mean difference of color change in conventional glass ionomer before and after topical application of fluoride in each group can be reviewed as listed below.

Group	Mean ± Deviation standard (mv)
NaF	0,4983 ± 0,05269
APF	1,7300 ± 0,11730
Sterile aquadest	0,1783 ± 0,05037

According to the data above, the means of color change in aquadest, NaF, and APF groups were 0,1783 mv, 0,4983 mv and 1,7300 mv respectively; the highest mean was found in APF group. Graph of mean difference of color change in conventional glass ionomer before and after NaF, and APF topical application, and control group (sterile aquadest), can be viewed below.

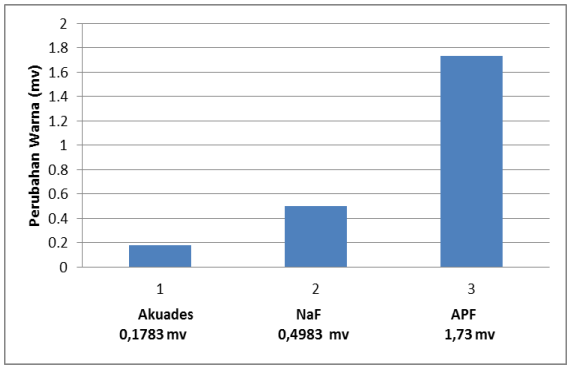

Figure. Mean difference of color change in conventional glass ionomer cement before and after NaF, and APF topical application, and control group (sterile aquadest).

The results of Shapiro-Wilk normality test for NaF, APF, and control group were (p=0,777), (p=0,666), and (p=0,735) respectively, with all data normally distributed (p>0,05). Levene's test's results revealed that all data had homogenous variants (p>0,05) which was (p=0,157).

One way ANOVA test revealed the value of (p=0,000) which meant H_0 was rejected and H_1 was accepted (p<0,05). H_0 rejected had the meaning that there was a significant difference of color change in conventional glass ionomer cement after topical application between NaF, APF, and sterile aquadest. Post Hoc LSD test was carried out to know which group showed the most difference (p<0,05); and the results were NaF compared to APF (p=0,000), APF compared to control (p=0,000) and NaF compared to control (p=0,000). Value of p<0,05 meant H_0 was rejected and there was a significant difference in all the groups.

DISCUSSION

According to one way ANOVA test and the mean difference of color change in conventional glass ionomer cement after fluoride topical application, we can come to an understanding that the results of this research concurred to the hypothesis which showed that there was a significant difference between two groups of NaF and APF topical application.

Color change measurement was carried out by placing He-Ne laser light source, OPT 101 type photo detector, whereas conventional glass ionomer cement's initial color of yellowish-white after fluoride topical application would turn whiter and a decrease in value could be observed on the microvolt digital.

Sensitivity to water is one of the conventional glass ionomer cement's characteristics that could affect its microstructures, solubility, and decrease the adhesion force between restoration and tooth surface. Conventional glass ionomer cement contains hydro-gel silica which is formed around the glass particles during setting process and has hydrophilic properties (easily bond to or absorbed by water) thus can cause color change through absorpstion.[14] Color change can also be caused by dehydration after setting which let glass particles become porous, and allow coloring substances penetrate into conventional glass ionomer cement.[15]

Researches about color change in glass ionomer cement after APF and NaF topical application showed that the color change in APF treatment group had a higher mean difference compared to the NaF treatment group. This was probably caused by the increasing roughness of surfaces caused by chemical erosion and acidity after APF application because of its acidic properties in its active components and the coloring substances contained. Fluoride absorption after topical application is the cause of color change in GIC.[11]

Contact between conventional glass ionomer cement and NaF increased the fluoride concentration in cement, even higher than the fluoride ions available to compete against carboxylate groups and form complex compound with Al3+ ions. Fluoride complex compound $[Al(H_2O)_{6-n}F_n]^{3-n}$ with $n \geq 2$ decreased the ion counts from cross-bonding and site-bounded aluminium. This caused eventual degradation of polyxilat matrix depending on concentration, time, and frequency of fluoride topical application, and then caused color change.

The high color change in APF group was probably caused by fluoride concentration in 1,23% APF which had pH value of 3,2 caused by orthophosporic acid and coloring substances in APF, meanwhile 2% NaF had neutral pH and did not contain added coloring substances. Fluoride concentration and acidic pH in fluoride topical preparation have the main roles in causing color change in conventional glass ionomore.[11,14,16,17,18]. As a conclusion, there was a difference of color change in conventional glass ionomer cement after topical fluoride application and the mean difference

of APF was higher compared to NaF treatment group.

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