

The differences of tooth density changes in the applications of 45% carbamide peroxide PF and 38% hydrogen peroxide PF as dental bleaching agents and after the application of 1.2% acidulated phosphoric fluoride

Devriza Jurnal, Setiawan Natasasmita, Endang Sukartini

Department of Conservative Dentistry Faculty of Dentistry Universitas Padjadjaran

ABSTRACT

The changes of tooth density is caused by the dissolutions of mineral enamel (demineralization) by bleaching agent. The purpose of this research was intend to know tooth density changes after the application of bleaching agent using 45% carbamide peroxide potassium fluoride (PF) and 38% hydrogen peroxide potassium fluoride (PF) and after the application of 1.2% acidulated phosphoric fluoride (APF). This research was true experimental in-vitro. Sample taking was by random sampling. The sample consisted of 32 maxillary central incisive permanent tooth. The tooth density were measured using RVG (Radiovisiography). The research results were analyzed and tested in pair and in pair of two sample for means using t student method. The conclusion of the research were decrease of tooth density after the application of bleaching agent with 45% carbamide peroxide PF and 38% hydrogen peroxide PF with statistically significant. After the application of 1.2% APF the density increased significantly but the density was lower than original density. There was no significant difference between bleached with 45% carbamide peroxide potassium fluoride and 38% hydrogen peroxide potassium fluoride.

Key words: Bleaching, hydrogen peroxide, carbamide peroxide, fluoride, tooth density.

INTRODUCTION

Today, people want to have healthy teeth and an attractive smile. Public awareness of the beauty of a smile with a row of white teeth is more based on performance requirements that will increase confidence in daily social intercourse. The color of tooth is a factor that affects the aesthetic. Discoloration of tooth often encourages patients to seek treatment which can whiten their tooth color.

The normal color of tooth is influenced by the dentin color, which is affected by the thickness

and translucency of enamel. Tooth discoloration can be either physiologic or pathologic, both of them caused by intrinsic and extrinsic factors. Discoloration may occur during or after the formation of enamel and dentin. Some spots appeared as the surface stains which emerged after the eruption which caused by the procedures of dental treatment.¹

The treatment techniques which performed to whiten the discoloration of tooth can be restorative, such as a crown-making, veneering, or by bleaching technique. Bleaching technique performed on tooth which experiences the discolor-

ation will whiten the color of tooth relatively quick without taking any dental tissue. Dental bleaching is an effort undergoing dental discoloration by using strong oxidizing materials. There are two types of dental bleaching techniques, i.e. internal dental bleaching which is performed on the tooth that have undergone endodontics therapy and external dental bleaching which is performed on the enamel surface without of any reduction. Bleaching materials as oxidizing agents react with the organic structure of dental hard tissue and slowly degrade into chemical products such as carbon dioxide so that the tooth look brighter. Reactions on decreasing oxidation which take place during the bleaching process are called redox reaction.²

External dental whitening for vital tooth can be done with various techniques such as in-office dental bleaching, supervised home dental bleaching or a combination of both. The dental whitening of in-office techniques are performed only at a dentist practice office because of the high concentrations materials usage. Technological advances today in dental bleaching make a possibility way to accelerate the time for whitening the tooth in the dental clinic.³

Some studies performed to determine the side effects of dental bleaching materials to the tooth and soft tissue. Some of the results found an increase in tooth sensitivity, roughness on the enamel surface, and incidence effects on the mouth soft tissue, decreasing levels of Ca/P, and decreasing the hardness of enamels. The process of solution on some mineral of the enamel which called as enamel demineralization will decrease the density of tooth.

One of the attempts to overcome these side effects is through adding fluoride in tooth whitening materials and smearing the fluoride after the tooth whitening. Fluoride ions will increase the saturation of dental bleaching and is

expected to reduce the demineralization during the bleaching process.⁴

Market bleaching agents used for in-office techniques of dental whitening are 38% hydrogen peroxide of potassium fluoride and 45% carbamide peroxide of potassium fluoride. Both of the dental whitening agents were provided by 3% of potassium nitrate and 1.1% of sodium fluoride. To determine the effect of both bleaching to the dental density, author interested in studying whether there were any differences in the tooth density changes after the application of 45% carbamide peroxide of potassium fluoride and 38% hydrogen peroxide of potassium fluoride as the whitening agents which is follow by the application of 1.2% Acidulated Phosphoric Fluoride (APF) after the process of dental whitening. In this study, the measurements of dental density was made with Radiovisiography (RVG) in Radiology Departement, Faculty of Dentistry, Universitas Padjadjaran Bandung.

MATERIALS AND METHODS

Type of the research used in this experiment was an in-vitro true experimental study. The population of the research was the maxillary incisors of first permanent tooth, with the criteria of free of dental caries and grafts, and the dental roots has perfectly shaped. The research sample were the 32 maxillary central incisors of permanent tooth which drawn at random.

Tools used in this study were tweezers, periodontal instruments (currete & scaler), stop-watch, contra angle hand piece, water and air spray, a unit of Radiovisiography (RVG), ruler, transparency, red and green markers. Material used was 38% hydrogen peroxide gel PF (Opalescence Boost pH 7), 45% carbamide peroxide gel PF (Opalescence Quick PF 45% pH 6.5), 0.9% solution of copy, red wax, extra fine polishing material

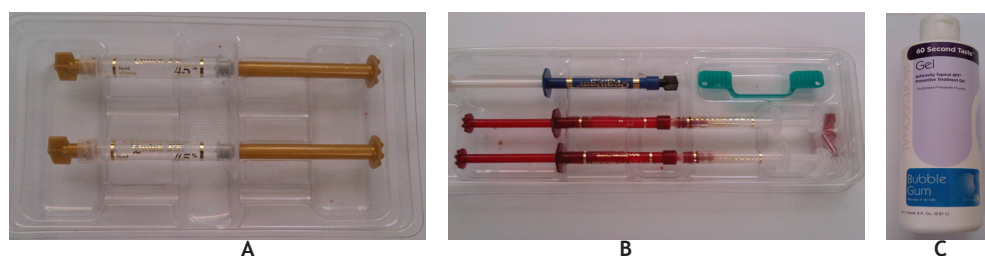


Figure 1. a. Opalescence boost (38% hydrogen peroxide PF gel); b. Opalescence quick PF (45% carbamide peroxide PF gel); c. 1.2% Acidulate Phosphat Fluoride (APF).



Figure 2. Teeth sample.



Figure 3. RVG AET ORIX 70.

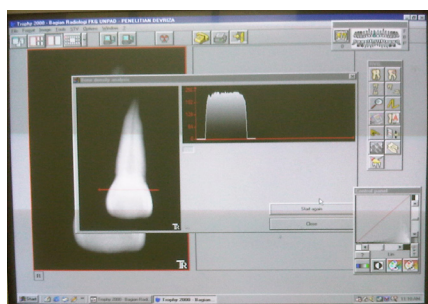


Figure 4. Analyzed the size of tooth.

(Dentsply), 1.2% acidulated phosphate fluoride (Professional 1.2% Gel-pascal dental).

Immediately after the tooth was pulled, cleaned the rest of the blood and soft tissue using a scaler, and then soaked in 0.9% saline solution until the time of use as a research sample. All labial surfaces of tooth cleaned and polished without any pressure by the extra fine and then cleaned with a fine water spray and dried with air spray. The red candle shaped into a box with a 2 cm long; 1.5 cm wide; and 1 cm high. The roots of tooth are planted in the red wax that has been formed so that only part of the crown was

visible, to assist the work technique during the study. RVG equipment prepared, by adjusting the distance of the cone to the tooth labial surface 5 cm, and the illumination time of 0.08 seconds. Captured with RVG all samples of control (without treatment). Calculation of the tooth density of the by putting a transparency that has been marked by vertical and horizontal lines on the screen, and then determined the four points at the meeting of X and Y axis on the labial surface of tooth, then measured the density at four points with of RVG programs software.

Sixteen of labial surface of tooth applied by 45% carbamide peroxide PF for 30 minutes and others 16 tooth surfaces with 38% hydrogen peroxide PF for 10 minutes, after that washed with running water. After bleaching, measured the tooth density again with the same way to the control. Immediately, applied the 1.2% APF on labial surfaces of tooth that have been in applied by 45% carbamide peroxide PF and 38% hydrogen peroxide PF for 5 minutes and measured its density. Analyzed the tooth density from all three dental treatment, i.e. before the treatment (control), after the application of 45% carbamide peroxide PF and 38% hydrogen peroxide PF, and the density after 1.2% APF application.

RESULTS

This study aimed to determine whether the density changes after the application of whitening agents, i.e. 45% carbamide peroxide PF, and with 38% hydrogen peroxide PF, and then after dental whitening 1.2% APF applied. Furthermore, to find out whether there were differences of tooth density changes after the using of bleaching agents 45% carbamide peroxide PF and 38% hydrogen peroxide PF.

Density measurements for each tooth performed on the four points which have been determined on the labial surface of tooth. Data observations and density measurements of tooth are presented in Table 1. Table 1 showed the average of dental density from sixteen tooth in Group I before of the treatment, after application of 45% carbamide peroxide PF as the bleaching agents and then after the application of fluoride (1.2% APF). Densities of teeth after application of 45% carbamide peroxide PF seemed lower

compared to the density of the control, but after 1.2% APF applications, the density of tooth have increased obviously. Similarly, the density of the tooth after bleaching with 38% hydrogen peroxide PF lesser compared to the density of the control and after application of 1.2% APF the tooth density had increased evidently. The data of average density before treatment in Table 1 shows the number of 234.50 ± 5.36 for the average density of the tooth in Group 1. In Group 2, the average density was 235.47 ± 7.80 . Then, after the application of 45% carbamide peroxide PF the Group 1 density of tooth changed to 232.88 and the Group 2 after the application of 38% hydrogen peroxide PF changed to 233.70 ± 7.66 . Group 1 and Group 2 had a density decline. After that, by giving 1.2% APF dental density in Group 1 increased to an average of 234.27 ± 5.2 and tooth density of the Group 2 increased to an average of 235.32 ± 7.76 .

The paired of data, then, analyzed by using T-statistics, which gave the following results: All of the measurements between the control (C), bleaching (B), and Fluorine (F) for each Group showed a significant difference statistically. This was shown with the value obtained by T-score was greater than the T-table value (2.13 for the 95% confidence level). Statistical analysis results showed that the changes of tooth density in the Group 1 after bleaching with carbamide peroxide PF showed the decreased density with an average of decline 1.63 which was statistically significant. The dental density changes in the Group 2 after bleaching with carbamide peroxide PF showed a decrease of density number by an average of 1.77 which is statistically significant. Decline in

density is due to the dissolving of enamel minerals (demineralization) by 45% carbamide peroxide PF and 38% hydrogen peroxide PF during the bleaching process.

DISCUSSION

Enamel demineralization process which decrease the dental density can be caused by the concentration factor of bleach materials. In-office material bleaching in this study was carbamide peroxide in high concentration PF 45% and 38% hydrogen peroxide PF. The higher of the concentration make the bleach oxidizing capacity also stronger. Strong oxidation ability of bleach in a high concentration can dissolve organic minerals and inorganic minerals.

Contact time of dental whitener to the tooth can affect the density changes.⁵ The longer the bleach in contact makes the more enamels minerals dissolving and the greater of the density changes. Application of bleaching agent in Group 1 that used 45% carbamide peroxide PF was done for 30 minutes and Group 2 using 38% hydrogen peroxide PF was done for 10 minutes; the applying of bleach was in accordance with manufacturer recommendations. Attin⁶ research concerning the

Table 1. The results of density measurements after the application of, 45% carbamide peroxide PF and 38% hydrogen peroxide PF.

Bleaching	Control	Bleach	Fluor
45% Carbamide peroxide PF	234.50	232.88	234.27
38% Hydrogen peroxide PF	235.47	233.70	235.25

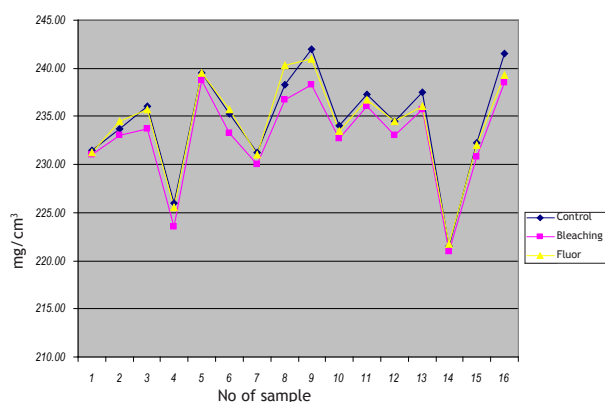


Figure 1. Density of tooth before and after the application 45% carbamide peroxide PF as whitening agents.

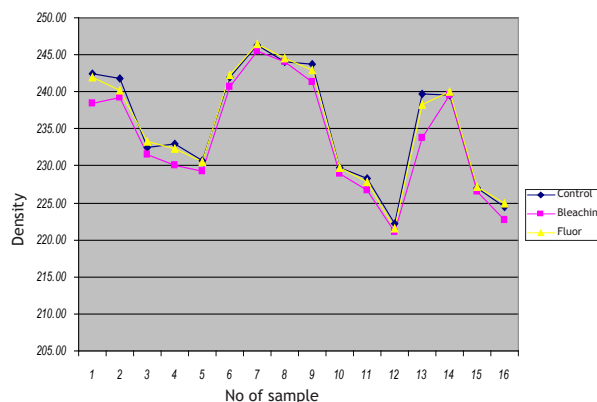


Figure 2. Density before and after the application of 38% hydrogen peroxide PF as bleaching agent.

Table 2. Similarity test on the dental density changes caused by 38% carbamide peroxide PF and 45% hydrogen peroxide PF.

Bleaching	No	B vs K	F vs K	F vs B
Carbamide peroxide PF 45%	Average	1.63	0.67	1.39
	Std	0.90	0.68	0.94
	N	16.00	16.00	16.00
Hydrogen Peroxide PF 38%	Average	1.77	0.59	1.55
	Std	1.56	0.42	1.13
	N	16.00	16.00	16.00
	Var gab	1.631	0.319	1.076
	Std gab	1.277	0.565	1.037
	t _{Count}	-0.31	0.39	-0.43

effects of low concentration bleach application of hydrogen peroxide with pH 5.7 and pH 7 for the dissolving of enamels organic minerals, showed that after applying bleaching materials for 8 hours, dissolving of enamel inorganic minerals continue to occur either by pH acid and pH neutral. Dissolving of organic minerals can be still occurred even if the pH of bleach is neutral in the adjoining time.⁶

Another factor that is affecting the dental density decrease is the pH of the tooth whitening agents. When the bleach pH contacted tooth enamel with a under critical value pH or about 5.5 then enamel demineralization will occur.^{7,8} The acidic material will diffuse into the intercrystal room and hydroxyapatite into the crystal itself, and then losen the molecular bonds of hydroxyapatite crystals and until finally the crystal mixed.⁹ Based on this theory, the process of the solubility of enamel mineral should not occur because of the bleaching pH used in this study are neutral, so that the dental density changes happened.

Changes in the density of the tooth after the application of 45% carbamide peroxide PF and 38% hydrogen peroxide PF, followed by 1.2% APF application showed an increasing density of the tooth with an average increase in Group 1 of 1.39 which was statistically significant while the average increase in Group 2 of which were statistically significant. The increase of the dental density was due to remineralization process of the application of fluoride (1.2% APF) for 5 minutes. Remineralization is a process of inorganic minerals attachment in an area that previously had lost of calcium and phosphate minerals.¹⁰ According to Reynolds¹¹, remineralizations are a diffuse process of calcium and phosphate ions into the enamel and then re-

place the lost minerals in the hydroxyapatite crystals. Enamel remineralization processes can occur from salivary activity of the oral cavity, giving fluoride and amorphous calcium phosphate. Some of fluoride provided in the enamel will enter the crystal lattice of hydroxyapatite formed fluorapatite or hidroxyfluorapatite. Enamel that has undergone a change due to tooth whitening will be porous so that the fluoride will penetrate into the enamel faster which can cause the faster remineralization process.¹²

The increase of dental density after application of 1.2% APF compared with the density before treatment (control) showed the density decrease with decreasing average density in the Group 1 was 0.67 which was statistically significant, while the average density decrease in the Group 2 was 0.59.

Figure 1 showed that a decline was occurred in the density of the control to the density after bleaching with 45% carbamide peroxide PF. Then, after 1.2% APF application as an effort for tooth remineralization to get back the original density but the density does not reach control density score like the density before treatment. Figure 2 showed that a decline was occurred in the density of the control to the density after bleaching with 38% hydrogen peroxide PF. Then, after the 1.2% APF application as an effort for the remineralization to improve back the dental density, however the density did not reach the original density before treatment (control).

Based on data from Table 1 and then analyzed whether there were any differences in the average change in dental density between the groups using 45% carbamide peroxide PF with the group using 38% hydrogen peroxide PF. The statistical analysis

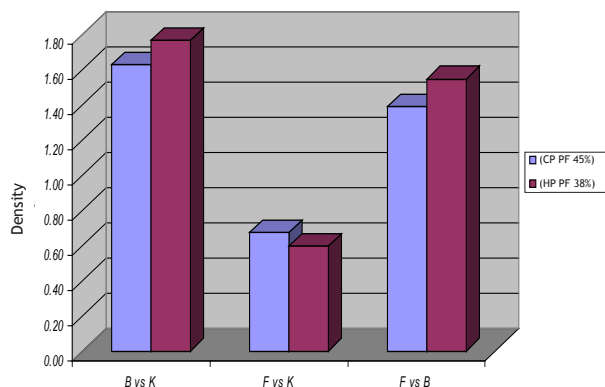


Figure 3. Density change of due to 45% CP PF and 38% HP PF.

was tested using a similarity test of two averages, which yields a test results as shown in the last row of data in Table 2. The statistical analysis of data in Table 2 by using a similarity test of two averages yields non-significant results, which means the density changes that occur did not show any significant differences statistically, between the average density changes in Group 1 that used 45% carbamide peroxide PF with average changes of Group 2 that used 38% hydrogen peroxide PF.

Table 2 showed the decreasing of dental density, commonly after the treatment given, in Group 1 using 45% carbamide peroxide PF compared with a reduction in the average density of Group 2 using 38% hydrogen peroxide PF, both showed the difference decreased was on an average density of 1.6 which is not statistically significant. This means that there was no significant difference in tooth density decrease after the use of whitener 45% carbamide peroxide PF compared with 38% hydrogen peroxide PF.

The difference of dental density changes after application of 45% carbamide peroxide PF compared with application of 38% hydrogen peroxide PF, followed by 1.2% APF application showed an increasing of average dental density on 0.319 which was not statistically significant. This mean that there was no difference in tooth density increase which was statistically significant after the dental bleaching application of 45% carbamide peroxide PF for 30 minutes followed by the application of 1.2% APF for 5 minutes compared with an increase of dental density after tooth whitener application of 38% hydrogen peroxide during 10 minutes followed by the application of 1.2% APF for 5 minutes. Visualization of the

differences in dental density changes due to the use of 45% carbamide peroxide PF compared with 38% hydrogen peroxide PF which then applied with 1.2% APF as seen in the Figure 3.

Based on the above explanation, a factor that responsible as the cause of decline in dental density after the process of dental bleaching with 45% carbamide peroxide PF ph 6.5 and bleaching with a 38% hydrogen peroxide PF was the result of dissolving enamel minerals. The causes of dissolving enamel mineral materials were the usage of whitening agents which have high concentrate; i.e 45% carbamide peroxide PF and hydrogen peroxide PF. However, the further research needs to prove this allegation.

Resistance ability and solubility of enamels crystals to the exposure of dental bleaching agents were varied on each different tooth. The difference of resistance ability and the solubility of enamel crystal due to the variation ratio of organic and inorganic composition of tooth enamel in each individual. The existence of these variations and differences in density changes cause differences results in each tooth after bleaching. With the application of fluorine (1.2% APF), fluoride ions will penetrate into the enamel and then replace the lost enamel minerals in the hydroxyapatite crystals.¹³

CONCLUSION

The density decrease was occurred significantly both on tooth that have been treated by carbamide peroxide potassium fluoride 45% and by hydrogen peroxide potassium fluoride 38%. Density increased significantly after the tooth was bleached and then applied fluoride (1.2% APF) compared with tooth that has been bleached without the application of fluorine (1.2% APF). There was no significantly difference in the density changes between the dental bleaching of 45% carbamide peroxide potassium fluoride and 38% hydrogen peroxide potassium fluoride.

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