

# **The difference of surface coarseness of high-copper amalgam restoration material before and after 38% hydrogen peroxide application by in vitro in-office bleaching technique**

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## **ABSTRACT**

Hydrogen peroxide is an effective agent to take off tooth colouring. This bleaching agent can cause microstructural change on amalgam restoration surfaces. The aim of this research is to know the difference of surface roughness of high-copper amalgam restoration materials before and after 38% hydrogen peroxide application by in-office bleaching technique. The sample was used consist of ten specimens of high-copper amalgam restorations which was applied by hydrogen peroxide 38%. The surface roughness was measured by surface tester (Surtronic 3P). The result of this research was reach by t-test paired calculation is the differences of surface roughness of amalgam restorations before and after first 15 minutes either second 15 minutes hydrogen peroxide 38% application didn't show significant differences. The conclusion of this research is no statistically significant difference of surface roughness of high-copper amalgam restoration materials before and after 38% hydrogen peroxide application by in-office bleaching technique.

**Key words:** Surface coarseness, high-copper amalgam, bleaching, hydrogen peroxide

## **INTRODUCTION**

Tooth has a role in constructing face esthetic and personality. One of the factors that influence tooth esthetic is tooth discoloration. Many individuals are yearning for white, clean and healthy teeth as those may help them to be more confident when communicating with others.<sup>1</sup>

Tooth discoloration is an esthetic issue that can influence people's appearance and may bring a negative psychological effect for the people. In keeping with that fact, today dentistry has given more consideration towards esthetic. One of the

techniques used is tooth whitening or bleaching.<sup>1</sup> Bleaching is a part of efforts to overcome tooth discoloration in order to get normal and well-colored teeth using a strong oxidant.<sup>2</sup>

Bleaching technique can be differentiated according to tooth vitality, that is intracoronal bleaching and extracoronal bleaching. Intracoronal bleaching technique is a whitening method of non vital tooth that has underwent root canal treatment by placing a strong oxidant inside the pulp chamber, whereas extracoronal bleaching technique is a whitening method of vital tooth underwent discoloration.<sup>1</sup>

Generally, extracoronal bleaching technique comprises of home bleaching and in-office bleaching. Home bleaching technique is more frequently used than in-office bleaching technique, due to its simplicity, practicality, low cost, and it can be performed at home by an individual. Some individuals want their teeth to be whiter in such a brief time, so in-office bleaching technique is the main treatment alternative for tooth whitening. This is made possible with the use of a highly concentrated bleaching agent and light or heat in order to accelerate the chemical reaction.<sup>3</sup>

The utilization of a highly concentrated and strong oxidant bleaching agent may lead a side effect. According to McGuckin et al.<sup>4</sup> after bleaching with 30% hydrogen peroxide, there is a change in tooth enamel morphology. This is supported by Wattanapayungkul and Yap<sup>5</sup> who stated that hydrogen peroxide with high concentration causes coarseness on tooth surface.

Besides its effect on tooth hard tissue, bleaching agent application may also affect amalgam restoration.<sup>6</sup> Amalgam restoration material is usually used as the restoration material for posterior teeth, whereas bleaching agent is applied on the anterior teeth. However, particularly for an individual with a wide smile line, it will generate a perception of anterior teeth region to be more posterior so the amalgam restoration inside individual's oral cavity will contact with the bleaching agent. The bleaching agent contact with an amalgam restoration may increase susceptibility towards corrosion and degradation, mercury (Hg) and silver release, as well as micro-structural changes of amalgam restoration material surface.<sup>7-10</sup> This may lead to surface coarseness of amalgam restoration. Surface coarseness of amalgam restoration is one of the physical characteristics that are clinically important, since a coarse surface of amalgam restoration increases bacterial adhesion capacity, causes plaque retention, tooth discoloration, gingival inflammation, and caries.<sup>5</sup>

Based on the background research above, the author is interested in carrying out a study on the difference of surface coarseness of high-copper amalgam restoration material before and after 38% hydrogen peroxide application using in vitro in-office bleaching technique.

## **MATERIALS AND METHODS**

**Material:** red wax (Anchor); decorative resin; cotton, high copper amalgam (SDI gs-80); artificial saliva; 38% hydrogen peroxide gel (opalescence extra boost).

**Tools:** cylindrical pipe; caliper; timer; mixing jar and spatula; glass lab; amalgamator; amalgam stopper and burnisher; micromotor (strong 207) and contra angle; polishing instruments. 10). Pincher and explorer; syringe and chip blower; rubber glove and mask; surface tester (Surtronic 3P).

**Procedure:** (1) Amalgam restoration specimen was prepared; (2) The first coarseness test was done by putting the probe of tester surface onto the amalgam restoration surface, and then the start button was pushed to activate the tester. Afterwards, the average of surface coarseness of amalgam restoration was obtained; (3) Bleaching agent was mixed with activator agent, and pumped for 20 times. 38% of hydrogen peroxide was then applied evenly with a thickness of 0.5-1 mm on the amalgam restoration, and left for 15 minutes. Thereupon, the region exposed with bleaching agent was cleaned by water and air sprays; (4) After the bleaching process was complete, the second coarseness test was done, that is a coarseness test after bleaching agent application; (5) Bleaching agent was re-applied for 15 minutes, and then it was cleaned by water and air sprays; (6) The third coarseness test was done; (7) All results were recorded and tested.

## **RESULTS**

The average value of surface coarseness of high copper amalgam restoration material is shown in the Tab.1 and diagram 1.

## **DISCUSSION**

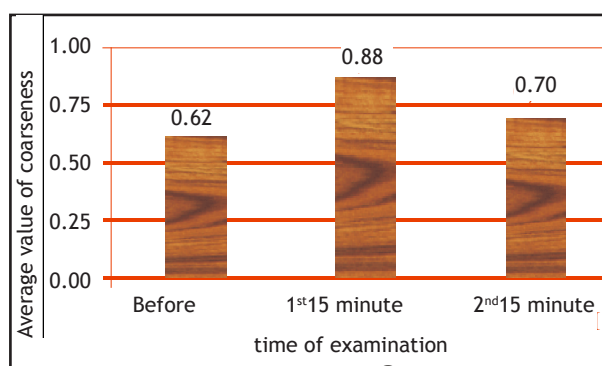
This study used 10 specimens of amalgam restoration that have been polished and soaked in artificial saliva. These ten specimens were given bleaching treatments twice with time interval of 15 minutes, and each treatment was measured by a surface tester.

Macroscopically, the surface of amalgam restoration before bleaching agent application

Table 1. The differences of surface coarseness of high-copper amalgam restoration material before and after hydrogen peroxide application 38%.

Differences	Differences of average ( $\mu\text{m}$ )	Deviation standard	Sample	$t_{\text{count}}$	$t_{\text{table}}$	Note
Before-after 1 <sup>st</sup> 15 minute	0,258	0,561	10	1,454	2, 262	$H_0$ - accepted
After 1 <sup>st</sup> 15 minute - after 2 <sup>nd</sup> 15 minute	-0,179	0,541	10	-1,047	2,262	$H_0$ - accepted
Before-after 2 <sup>nd</sup> 15 minute	0,079	0,435	10	0,575	2,262	$H_0$ - accepted

Diagram 1. The average value of surface coarseness of high copper amalgam restoration material.



appeared soft and glossy. This condition was also seen on amalgam restoration after bleaching agent application.

Measurement using Surtronic 3P was carried out in order to find out the microscopic condition of the specimen. The result of this surface coarseness of amalgam restoration was then tested using paired t-test. The results are shown in Diagram 1 and Tab.1 Based on the results, the hypothesis given by the author in the first chapter is accepted, i.e. there is no significant difference of surface coarseness of amalgam restoration before and after the first and the second 15 minutes of 38% hydrogen peroxide application.

This result is in accordance with the results of Silva et al.<sup>11</sup> where there is a change in coarseness value before and after hydrogen peroxide application of high concentration, but the results was not statistically significant. Moreover, the study by Scemehorn et al.<sup>12</sup> shows the same result when they used a Scanning Electron Microscope to evaluate the surface of admixed high-copper amalgam specimen with the application of tooth whitener gel containing 6% of hydrogen peroxide for 20 minutes as many as 28 treatments. Also, the results of the study by Ahn et al.<sup>13</sup> show that there is no significant change in the morphology of amalgam surface treated using

carbamide peroxide.

The process of coarseness change of amalgam restoration treated with an oxidant agent has yet to be firmly understood. As a rule, the surface coarseness of amalgam restoration inside the mouth occurs due to the process of abrasion resulted from mastication pressure, acidity, which is accelerated by the process of corrosion on the amalgam restoration.<sup>14</sup> According to the previous studies, surface coarseness of amalgam restoration is related to micro-structural changes of amalgam restoration surface. Rostein et al.<sup>15</sup> explained that oxidation, dissolution, and corrosion may occur on the surface of amalgam restoration treated with a bleaching agent. These three processes increase the release of Hg significantly.

According to a study by Al-Salehi et al.<sup>16</sup> it is stated that despite the release of metal ions, SEM investigation and coarseness test using Talysurf show that, there is no significant coarseness on amalgam specimens. The average coarseness of the surface of cylindrical unicompositional spherical high-copper alloy amalgam specimens with a diameter of 10 mm and height of 2 mm after carbamide peroxide application is 2.23  $\mu\text{m}$  (0.47).

The release of metal ions on amalgam occurs from early manipulation and during inside the mouth. The Hg release occurs because of condensation, polishing, corrosion, acidity, and heating.<sup>8</sup> The release of metal ions is also influenced by pH, concentration, as well as exposure duration of the bleaching agents.<sup>17</sup>

The results of the study are not significant because since the beginning amalgamator was used in the manipulation to obtain plastic and homogeneous mass which will experience condensation easier. After 24 hours from condensation, polishing was then carried out. According to Svare and Chan<sup>18</sup>, polishing is intended to reduce surface microporosities, so it generates

homogenous regions, as well as to reduce surface corrosion of amalgam. High-copper amalgam used in this study has more ability to resist the process of corrosion compared to low-copper alloy. This process of corrosion occurs when there is a temperature fluctuation, pH change, and the presence of electrolyte.<sup>19</sup> In this study, amalgam specimen was soaked in saliva of pH 7 and the bleaching agent used was 38% hydrogen peroxide of pH 7; so there was no pH change. In addition, the temperature used in the study was room temperature. Room temperature is lower than mouth temperature. This leads to slower process of corrosion.

According to Rotstein et al.<sup>17</sup> pH of bleaching agents is one of the factors that make the process of Hg dissolution significant. This is due to the fact that bleaching agents with low pH result in the loss of thin layer of oxide, so Hg will be oxidized and released to the solvent. Moreover, Soh et al.<sup>20</sup> explained that Hg release at pH 2.5 occurs more than of pH 7.

Other factors that cause microstructural changes of amalgam restoration are the concentration of the hydrogen peroxide and the exposure duration on the surface of amalgam restoration. Highly concentrated bleaching agent used in this study, i.e. 38% hydrogen peroxide. According to Certosimo et al.<sup>10</sup> the increased concentration of hydrogen peroxide results in increased oxidation, corrosion, and dissolution processes of amalgam restorations. Based on the duration of hydrogen peroxide exposure, i.e. 15 minutes for each procedure (based on the manufacturer's recommendation) there was no change of coarseness on amalgam surface. Rotstein<sup>15</sup> explained that micro-structural changes occur in prolonged bleaching treatments. This is due to fact that the more bleaching agents contact the amalgam, the more oxidation and dissolution processes occur on the surface of the amalgam.

According to Rismanto<sup>3</sup>, in office bleaching technique, generally tooth whitening takes place more or less one hour, with bleaching agent application of two or three times. Therefore, the author carried out two 38% hydrogen applications to find out whether more frequent bleaching agent application will affect the coarseness of amalgam restoration material. However, the results of the second exposure did not show any significant

change.

This bleaching agent is chemical-activated, that is the agent is activated using a chemical substance and the activation can be achieved without radiation. According to Rismanto et al.<sup>3</sup> radiation will accelerate hydrogen peroxide dissociation and increases the temperature of bleaching agents. Increased temperature may lead to corrosion process of amalgam restorations.

Another factor that makes the results to be insignificant is the use of fresh amalgam specimens. The purpose of this is to reduce intervening factors in the study. Amalgam restoration which has been already inside the mouth may probably have experienced Hg release and abrasion as the result of activities in the mouth cavity. In addition, the process of corrosion may also have happened.

Based on discussion above, it is proven that 38% hydrogen peroxide application did not significantly cause surface coarseness of amalgam restoration when used according to the directions of the manufacturer.

## CONCLUSION

Based on study results and discussion, it can be concluded that there is no significant difference on the surface coarseness of high-copper amalgam restoration before and after the first and the second of 38% hydrogen peroxide application of 15 minutes using in-office bleaching technique.

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