The effect of difference in saliva pH against Hg release from amalgam restoration on in vitro research

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ABSTRACT

Hg release from amalgam restoration is continuos as long as amalgam in the mouth. Difference in saliva pH is one factor that influence Hg releasing from amalgam restoration. The purpose of this research was to find data the effect of difference in saliva pH against Hg release from amalgam restoration. This research was a true experimental in vitro research. This research used 40 samples of premolar teeth of the maxilla, prepared in occlusal Class I, restored with amalgam, and then divided into 4 Groups. Teeth belonging to Group 1 were immersed in saliva artificial with a pH content 5, Group 2 with a pH content of 6, Group 3 with a pH content of 7 as a control, and Group 4 with a pH content of 8. All tooth Groups were immersed for one week after condensation. Research data results analyzed using the One-Way Analysis of Variance (ANOVA). Research results measured using the Atomic Absorption Spectrophotometry (AAS) indicated that Group 1 with a pH content of 5 had the highest average release, namely, 19,276 ppb, followed by Group 4 with a pH content of 8, with a Hg release of 17,691 ppb, followed by Group 3 with a pH content of 7 as a control, with a Hg release of 13,702 ppb, and Group 2 with a pH content of 6 the lowest Hg release, namely 12,377 ppb. Summary of this research showed that there was no effect of saliva pH difference against Hg release from amalgam restoration.

Key words: Hg release, saliva pH, amalgam restorations.

INTRODUCTION

In dentistry, amalgam is well known as one of dental restoration materials. Dental amalgam is made of alloy metal powder mixture, such as silver (Ag), and tin (Sn), and copper (Cu) and sometimes zinc (Zn) with liquid mercury (Hg). Hg is a toxic substance for human body. Amalgam utilization as restoration material is often argued due to the harzadous Hg content for the patient or operator. Hg digestion in Minamata case has shown that Hg is the causal factor for several diseases, such as paralysis, deaf, tremor, and central nervous system disorder when the local inhabitants consumed Hg-contaminated tuna. That particular case has led to anxiousness and fear among dentists and patients.
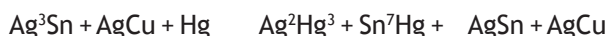
Hg release from amalgam restoration happens continuously during the time the amalgam is still in the mouth. One of the affecting factors is oral acid environment mechanism. Hg release from the amalgam restoration could happen during amalgam placement into cavity (condensation), polishing, restoration removal, chewing, brushing, and corrosion. The corrosion may be caused by the presence of various different amal-

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gam restorations, un-homogenous restoration surface, and saliva pH level differences.

Based on the copper content (Cu) in alloy, amalgam is differentiated into two, i.e. Low Copper Amagam (Conventional Alloy) and High Copper Amalgam.

Dental amalgam reaction of high copper amalgam:

First reaction:

$$Ag^3Sn + AgCu + Hg \qquad Ag^2Hg^3 + Sn^7Hg + \quad AgSn + AgCu$$

Second reaction:

$$Sn^7Hg + AgCu \qquad Cu^6Sn^5 + Hg^2Ag^3$$

This study uses High Copper amalgam due to higher cooper-content that makes high copper amalgam stronger than low copper amalgam.

Saliva is produced by the salivary glands and is delivered into oral cavity and distributed through gum gingival sulcus. The normal saliva pH level is between 6.4 to 6.9. There are two general physiology functions, the first is as lubrication liquid in helping food to pass the upper digestion channel and stimulate the ptyalin function and the second, saliva can cover the soft and hard tissues inside oral cavity. Hg in the body can be detected by examining blood, urine, hair, and saliva. This study uses artificial saliva, i.e. salisynth, to replace the real saliva. The artificial saliva composition is: KCl 0.63 gr, NaCl 0.13 gr, $MgCl^2$-$6H^2O$ 0.87 gr, $CaCl^2$-$6H^2O$ 0.33gr, K^2HPO^4 1.05 gr, KH^2PO^4 0.33 gr, NaF (mg) 4.42 mg, KCNS 0.10 gr, and 1000 ml of Aquades.[7]

According to a study performed by Takaku[9], the Hg level in refined water media is 34 ± 0.042 ppb, in HCL media 0.5% is 75 ± 0.0035 ppb, and in lemonade hydrochloride is 71 ± 0.0157 ppb. The result shows that Hg level in acid environment is higher. The purpose is to know the effect of saliva pH difference towards Hg release in amalgam restoration.

MATERIAL AND METHODS

This study is a true experimental study and the population has several criteria as follow: maxillary premolar; caries free teeth; teeth with complete roots. The sample consists of 40 maxillary premolars of random population.

The study was performed in Pusat Teknologi Nuklir Bahan dan Radiometri (PTNBR) Laboratory Bandung located at Jalan Tamansari No. 71 in the period of April-June 2007.

This study procedure includes the following steps: (1) Preparation of 40 maxillary premolars which were then divided into 4 Groups, i.e. 1, 2, 3, and 4; (2) Each tooth was invested in dental stone, outlines were then made with a mesiodistal width of 3 mm, isthmus width of one third bucal-palatinal distance, and 3 mm cavities were made using inverted cone drill no.3; (3) Perform class I occlusal amalgam preparation by opening the cavity using round drill, then extending it. Undercut is made using inverted cone drill, then the cavity was smoothed using fissure drill, until the tooth was cleaned from dentin debris; (4) Prepare the restoration material, which was SDI high copper amalgam; (5) Amalgam was triturated using amalgamator for 8 seconds and then placed in the cavity using amalgam gun and was manually condensed by 4 kg of condensation pressure, based on the measurement using body scale; (6) Restoration was completed by carving process according to the dental anatomy; (7) Restored premolar was removed from the block and cleaned; (8) Each Group was bathed in 25 ml volume of artificial saliva with different pH levels: Group 1 with pH level of 5; Group 2 with pH level of 6; Group 3 with PH level of 7 as control; Group 4 with pH level of 8; After 24 hours bathe, each tooth was removed from the artificial saliva and polished using polishing materials; Polished teeth from 1,2,3, and 4 Groups were re-bathed in the artificial saliva according to the specified pH level.; After one week bathed, the teeth were removed from the artificial saliva and the bath were centrifuged for 20 minutes to obtain homogenous solution, so the measurement could be easily performed; Then the Hg level measurement was performed on the artificial saliva using Absorption Spectrophotometry (AAS).

Data obtained from the result were then analyzed for the mean value and then assessed statistically using One-Way Variance Analysis (ANOVA)

RESULTS

The study was performed on 40 maxillary premolars that were divided into 4 Groups and

prepared by class I amalgam occlusal preparation. After preparation, Group 1was bathed in pH 5 artificial saliva bath, Group 2 in pH 6 bath, Group 3 in pH 7 bath, and Group 4 in pH 8 bath. The bathe was performed for one week after condensation. The measurement result of Hg level release from class 1 occlusal amalgam restoration in artificial saliva bath measured using Atomic Absorption Spectrophotometry (AAS) produces mean values as presented in the table.

To understand the effect of saliva pH differences on Hg release from in vitro amalgam restoration, One-Way Variance Analysis (ANOVA) was performed.

Table 2 above shows that F_{table} of 2.866 is bigger that F_{calc} of 1.290. According to this result, it can be concluded that the assessment accepts null hypothesis (Ho), which means that there is no effect of saliva pH difference on Hg release from in vitro amalgam restoration.

DISCUSSION

Table 1 shows that Group 1 with pH5 has the highest Hg release mean value, which is 19.276 ppb. This due to the fact that thin acid film layer (SnO) will be dissolved in the acidic environment, resulting in Hg release[11] Group 4 with pH 8 has Hg release mean value of 17.681 ppb. Group 3 with pH 7 as the control Group has a mean value of 13.701, and Group 2 with pH 6 has the lowest value of 12.037 ppb.

Table 2 shows that there is no effect of saliva pH difference on Hg release from amalgam restoration due to the fact that F_{table} value of 2.866 is higher than F_{count} value of 1.290, so it can

be concluded that the assessment accepts null hypothesis (Ho).

This is in accordance with the study performed by Marek[11] about Hg release from amalgam dental in artificial saliva with pH 1-8 where he stated that Hg release in γ1 (Ag-Hg) phase is high in artificial saliva with pH 1 and 2. While in pH 3-8, there is no significant difference. Hg release in pH 1 and 2 has a high value due to the fact that the protective thin layer in restoration surface becomes thin and silver (Ag) is also dissolved in acidic environment resulting in Hg ion release and Hg level increase in the restoration surface. While in pH 3-8, it only causes Ag ions to dissolve without stimulating Hg ion to dissolve. In astudy performed by Takaku[9], Hg level in HCL 0.5% media is shown as ranging in 75 ± 0.0035 ppb, and in lemonade hydrochloride media it ranges in 71 ± 0.0157. It shows that in the acidic media, Hg release level does not show any significant difference.

Several factors that may affect Hg release from amalgam restoration include amalgam placement timing into cavity (condensation), polishing, and restoration removal.

CONCLUSION

Based on this study, it can be concluded that there is no effect of saliva pH difference on Hg release from amalgam restoration. It is suggested that dentists should observe the oral condition of patients who are going to be receive amalgam restoration by counting total number of amalgam restorations in the patient mouth. Amalgam restoration should not be used in patients with bulimia,

Table 1. Hg release level mean in artificial saliva with pH 5, 6, 7 and 8.

	Hg level (ppb)			
	pH 5	pH 6	pH 7	pH 8
Mean	19,276	12,037	13,702	17,691

Table 2. One-Way Variance Analysis on the effect of saliva pH differences on Hg release from in vitro amalgam restoration.

Variance source	DK	JK	KT	F_{count}	F_{table}	Criteria
Inter-groups	3	341,642	113,881	1,290	2,866	Ho accepted
In-group	36	3179,281	88,313			
Total	39	3520,923				

peptic ulcer, xerostomia and others diseases that decrease saliva pH.

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