The Differences in Hg content released from high copper amalgam and silverfil argentum restoration into artificial saliva after one week of soaking (in vitro)

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ABSTRACT

Dental restoration is a treatment in dentistry that very often implemented. One of the restoration materials used is amalgam. Amalgam has some deficiencies, among others, the presence of free Hg. The purpose of this study was to find out the differerence in Hg content released from two different kinds of amalgam, namely, high copper amalgam and silverfil argentum carried out in vitro. This study was carried out on thirty premolar teeth of the maxilla which underwent class one occlusal restoration. The Hg content released was measured using the Atomic Absorption Spectrophotometry (AAS). This was a quasi-experimental study. The study results analyzed using the independent t paired statistical test method indicated that after one week of immersion, the average Hg content released from high copper amalgam restoration was 10,695 ng/mL and from silverfil argentum restoration was 5,602 ng/mL. The conclusion of the study was that there was a difference in Hg content released from high copper amalgam restoration and silverfil argentum restoration. The Hg content released from high copper amalgam restoration was higher than the Hg content released from silverfil argentum restoration.

Key words: Hg content, high copper amalgam, silverfil argentum

INTRODUCTION

Dental restoration is one of the most frequent treatments performed in dentistry, especially in dental conservation field. One of the restoration materials used is amalgam which is a mixture of alloy and liquid mercury (Hg). The amalgam used in dentistry is dental amalgam.[1] Dental amalgam is made from a mixture of Hg with another alloy that contains silver, lead, copper and sometimes zincs.[2]

Dental amalgam has several disadvantages including the presence of free Hg that may cause side effects, the possibility of leak that may create secondary caries and the contrast color compared to the dentition color.[3] The Hg contained in an amalgam restoration can be released into the oral cavity if the treatment procedure and the usage of this material are not appropriate.[4] The release of Hg ion from an amalgam restoration may also be caused by the corrosion product produced, incorrect manipulation, amalgam restoration removal, acid condition in the mouth induced by food, drink or acid from microorganism metabolism and oxidation process by carbamide-peroxide chemical compound or H_20_2.[5]

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Patients who have amalgam restoration shows that the amount of Hg vapor inhaled in 24 hours is 1.7 µg/day and in patients with 8 to 10 amalgam restoration it is ranging from 1.1 to 4.4 µg/day. Other researches also shows that an average blood Hg level in patients who have amalgam restoration is 0.7 ng/mL compared to 0.3 ng/mL in patients without amalgam restoration.[6]

The release of free Hg from amalgam restoration can still happen although the amalgamation process has finished. A study has shown that there are some Hg released from amalgam class two restoration without polishing in artificial saliva from the first day up to the seventh day and that the level of Hg released increases sharply on the second day.[7]

According to Marek[8], Hg that is released in the form of vapor will penetrate the respiratory tract while Hg in ionic form will be accumulated in saliva and enters the body through the digestive tract. This can affect health and will manifest in the form of headache, kidney function disorder, reproductive system disorder and cancer.[8] Hg poisoning can also trigger symptoms in oral cavity such as gingivitis, periodontitis, gingival discoloration, hyper-salivation and metal taste.[9]

Along with the recent development, now an amalgam without Hg has been discovered and is referred as silverfil argentum. Silverfil argentum is a mixture of silver dust and Hg that is manufactured to restore tooth, harden when it dries and does not contain free Hg. The silver dust used for this purpose is very reactive and bind all Hg mixed. According to a research performed by The City University, it is revealed that silverfil argentum is safe for human body.[10]

A study that is performed to mouse's peritoneal subcutaneous tissue due to application of silverfil argentum shows that the reaction towards foreign body, i.e. silverfil argentum does not show any severity during the 4 week of treatment and all reactions found are reversible, which is characterized by no increase in plasma cells. This proves that during the 4 week treatment, silverfil argentum is considered as a friendly matter by the body.[11]

Based on those arguments, the author performed a study to discover the difference in Hg level released from the two different amalgam types, i.e. high copper amalgam and silverfil argentum.

MATERIALS AND METHODS

This study uses a pure experimental method and the sample used consists of thirty upper premolar teeth with the following criteria: free from caries, root is perfectly formed and is taken from student or dentist work clinic.

The study steps include: Preparing 30 upper premolars; Embedding teeth in plaster and making class one occlusal preparation with a mesiodistal width of 4 mm and buccopalatal width of 2 mm and a depth of 3 mm measured by a pair of calipers; Cleaning the teeth from dentinal debris and dividing the teeth into two groups, each contains 15 premolars; Preparing amalgam restoration materials by triturating high copper amalgam and silverfil argentum using amalgamator; Condensing high copper amalgam manually in group I premolars with 4 kg of pressure measured using body scale and making anatomical form at the occlusal part according to the dental contour; Condensing silverfil argentum manually in group II premolars with 4 kg of pressure measured using body scale and making anatomical form at the occlusal part according to the dental contour; after finished, the sample was removed from the plaster block and then cleaned; Thirty restored teeth were then soaked individually in a plastic container containing 25 ml artificial saliva until all restoration surface was soaked by artificial saliva.

The artificial saliva used had a pH of 7 with a composition of KCl (0.63 gr), NaCl (0.87%), $MgCl_2$-$6H_2O$ (0.13%), $CaCl_2$-$6H_2O$ (0.33 g), K_2HPO_4 (1.05 g), KH_2PO_4 (0.33 g), NaF (4.42 g), KCNS (0.1 gr), and aquadest (1000 ml). After 24 hours, the restoration was then polished using polishing stone and polishing rubber until the surface was smooth and shiny. The teeth that had been cleaned and polished were then put back to the plastic container. After one week since the condensation, the dental amalgam was removed from the artificial saliva. The artificial saliva was then centrifuged for 20 minutes so that the solution became homogenous. The Hg level in the artificial saliva was then measured using Atomic

Absorption Spectrophotometry (AAS).

This study is a comparative study with the study data analyzed using independent two mean similarity statistical test (t) with a confidence level of 95% (α=0.05).

RESULTS

The study was performed to 15 upper premolars restored by high copper amalgam and 15 upper premolars restored by silverfil argentum with the aim of discovering the Hg level released from the two different types of amalgam, i.e. high copper amalgam and silverfil argentum in upper premolar class one restoration in vitro after a week of soaking. The Hg level released in this study is listed in table 1.

Table 1. Results of Hg level released in the artificial saliva after one week of soaking.

Sample	High Copper Amalgam (ng/mL)	Silverfil Argentum (ng/mL)
1	6.854	2.859
2	8.741	2.846
3	15.643	6.682
4	9.192	1.169
5	7.949	8.294
6	11.705	2.509
7	10.609	1.999
8	5.959	3.513
9	17.106	5.427
10	12.862	11.850
11	9.623	7.243
12	17.858	6.954
13	4.776	3.619
14	5.601	3.422
15	15.945	7.550
Average	10.695	5.062

DISCUSSION

The measurement of Hg level released from two different types of restoration, i.e. high copper amalgam and silverfil argentum after one week of soaking shows a significant different.

Table 1 shows that the Hg level released from high copper amalgam restoration into the artificial saliva is ranging from 4.776 ng/mL to 17.858 ng/mL, meanwhile in silverfil argentum restoration, the Hg level released is ranging from 1.169 ng/mL to 11.850 ng/mL and the average Hg level released from high copper amalgam restoration is higher than the average Hg level released from silverfil argentum restoration.

High copper amalgam is a dental amalgam that is most resistant to corrosion because it does not contain phase γ_2 which is most susceptible to corrosion. Most of Sn from phase γ_2 in high copper amalgam reacts to Ag (AgCu) to form Cu_6Sn_5 which is called phase η. This phase η has a more stable reaction and more resistant to corrosion.[12]

Based on the results of the study, it can be observed that the Hg level released from silverfil argentum restoration is lower than the high copper amalgam restoration. This can be caused by the different composition of high copper amalgam and silverfil argentum.

Silverfil argentum has a ratio of Hg to Ag that is better that it can bind free Hg released from dental amalgam. In addition, silverfil argentum also contains a very reactive Ag that can bind free Hg produced.[10]

In this research, the presence of Hg released by high copper amalgam and silverfil argentum can be caused by corrosive product, incorrect manipulation and incorrect polishing. According to Marek[8], the release of Hg ions from the amalgam restoration in the mouth can be caused by, among others, corrosive product, incorrect manipulation and incorrect polishing, amalgam restoration removal and acid environment in the mouth. Other things that may induce Hg release from a restoration is the presence of masticatory load, scratch, and friction.[13] Besides, Hg release will be more stimulated after chewing, tooth brushing, smoking and drinking hot beverages.[9]

Based on a research performed by Halbach [14], the Hg level in saliva from twenty people who have 1-46 amalgam surface is 0.3 µg/day with 13.9 µg/day with an average Hg level of 4.5 µg/day. According to Mayer[15] the Hg level in saliva from a high copper amalgam restoration with a surface size of 50 mm^2 after five days is 0.5 µg. Several other studies on the corrosion process shows that in vitro Hg release in several artificial saliva in a short term is ranging from 4 to 20 µg/day and Hg release will decrease in a longer term. The Hg level released in vitro compared to the Hg level released

in the mouth shows some differences. This may caused by the different saliva composition and the oral cavity environment.[16]

CONCLUSION

Based on this research it can be concluded that there is a difference in Hg level released from high copper amalgam restoration and silverfil argentum restoration that the Hg level released from high copper amalgam restorations is higher compared to the Hg level released from silverfil argentum restorations. Therefore, dentists and other staff who work in the dentistry area should be careful in selecting amalgam restoration material and should show efforts for preventing Hg pollution in dentistry so that the adverse effects produced can be handled. Further research should be performed with a longer duration of experiment to discover the size of effects caused by amalgam filling materials.

REFERENCES

1. Roberson TM, Heymann HO, Ritter AV. Studevant's art and science of operative dentistry. 4th ed. St. Louis: Mosby Inc.; 2002. p. 148-70.
2. Craig RG, O'Brein WJ, Powers JM. Dental materials properties and manipulation. 6th ed. St. Louis: Mosby Inc.; 2002. p. 79-93.
3. Baum P, Lund RW. Buku ajar ilmu konservasi gigi. 3rd ed. Jakarta: EGC; 1995. p. 331-5.
4. Combe EC. Notes on dental materials. 6th ed. New York: Curchill Livingstone; 1992. p. 100-7.
5. Kanzil LB, Santoso R. Efek samping pemakaian bahan pemutih gigi terhadap restorasi amalgam. Majalah Kedokteran Gigi FKG USAKTI 2002;49:99-104.
6. Anusaviece KJ. Phillip's science of dental materials. 11th ed. St Louis: WB Saunders Co.; 2003. p. 495-541.
7. Willy B. Kadar Hg yang terlepas dari restorasi Kelas II Amalgam yang telah dipoles serta direndam dalam saliva buatan (In vitro) [Skripsi]. Bandung: Fakultas Kedokteran Gigi Universitas Padjadjaran; 2002.
8. Marek M. Dissolution of mercury vapor in stimulated oral enviroments. Dent mater 1997;13:312-5. In: Kanzil LB, Santoso R. Efek samping pemakaian bahan pemutih gigi terhadap restorasi amalgam. Majalah Kedokteran Gigi FKG USAKTI 2002;49:99-104.
9. Horsted. Tambalan amalgam berbahaya untuk kesehatan. Jakarta: EGC; 1999.
10. Radhakrishnan. Silverfil argentum dental product. [cited 2006 Des 5]. Available from:http://www.silverdental/Product. ARGENTUM.htm.
11. Handayani I. Reaksi Jaringan terhadap pemberian silverfil argentum [Skripsi]. Bandung: Fakultas Kedokteran Gigi Universitas Padjadjaran; 2006.
12. Herda E. Pengaruh penambahan paladium terhadap perilaku thermal amalgam tembaga tinggi tipe lathe cut. J Kedokteran Gigi UI 2002;9:39-42.
13. Yuming Li. Dental amalgam: update on safety concern. JADA 1998;129:494-502.
14. Mayer R. Zur Toxizittation quseksilber un/oder amalgam. Deutche Zahnazlicher Zeitsfrift 1990:35:450-456. In: Eley BM, Cox SW. The release, absorption, and possible health effects of mercury from dental amalgam: A Review of recent findings. Dent Review 1994;6:10-8.
15. O'Brein WJ. Dental materials and their selection. 3rd ed. Chicago: Quintessence Publishing Co. Inc.; 2002. p. 175-90.