Investigation Mercury Concentration in Saliva Among Volunteers with Different Dental Amalgam Fillings

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Abstract

In this study the concentration of mercury was measured in saliva of Iraqi people who divided into three groups having ,dental amalgam filling ,the first group was 25 volunteers ,(18 males and 7 females)have one amalgam filling ,the second was 22 volunteers (14males and 8females) having two dental amalgam filling ,while the third group having three dental filling 20 volunteers(15 male and 5 female)) ,The saliva 5ml was collected for 10 min.,and the released mercury was measured by flameless atomic absorption spectrophotometer. The results observed that the volunteers with one amalgam filling have 3.644 ug/l , the second groups with two amalgam filling have 7.4210 ug/l mereury in their saliva the third group who with three filling have 21.29 ug/l. these results indicating to use alternative filling materials by the dentist and to pay attention to mercury exposure in dental clinic and patients mouth to reduce the side effect of mercury release from dental amalgam filling.

Key word: Amalgam; Saliva and Mercury.

استقراء تراكيز الزئبق في لعاب متطوعين عراقين لديهم اعداد مختلفة من حشوات الاملغم في أسنانهم

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الخلاصة

في هذة الدراسة قيست تراكيز الزئبق في لعاب متطوعين عراقيين ،تم تقسيمهم الى ثلاث مجاميع اعتماداً على عدد حشوات الاملغم في اسنانهم وكانت المجموعه الاولى تتألف من (25) متطوع (18 ذكور و 7 اناث) من الذين لديهم حشوة واحده في اسنانهم ،المجموعه الثانية تتألف من (22)متطوع (14 ذكور و 8 اناث) يمتلكون حشوتان، اما المجموعة الثالثة فتتكون من (20) متطوع (15 ذكور و 5 اناث) يمتلكون ثلاث حشوات اسنان ، جمع (5)مل من لعاب هؤلاء المتطوعين خلال عشرة دقائق وقيست كميه الزئبق المتحرر في اللعاب باستخدام جهاز الامتصاص الذري عديم اللهب بينت النتائج ان تركيز الزئبق في المجموعه الاولى كان (3,644) مايكرو غرام /مل في حين كان تركيز الزئبق في المجموعه الثانيه (7,421)مايكرو غرام /مل و اما المجموعه الثالثة فكان تركيز الزئبق فيها (21,29) مايكروغرام/مل، ومن هذه النتائج يمكن القول انه من المستحسن ان تستعمل حشوات ترميميه بديلة من قبل طبيب الاسنان و اخذ الحيطه والحذر من تحرر الزئبق في عيادة الاسنان وانتشارة في فم المريض لتقليل الاضرار الجانبية للزئبق المتحرر من حشوات الاملغم في الاسنان .

الكلمات المفتاحية:الاملغم ، اللعاب والزئبق .

Introduction

Dental caries is a multifactorial disease, for caries to develop three factors must occur simultaneously which are: susceptible tooth, cariogenic tooth associated microorganism and cariogenic diet for non-defined, but infinite period of time (Appleto and Christan;1995) . Dental caries is defined as a progressive irreversible microbial disease affecting the hard parts of the tooth exposed to the oral environments , resulting in demineralization of the inorganic constituents and dissolution of the organic constituents, there by leading to a cavity formation. (Peter;2003). Dental cavities are treated by drilling out the decayed material and replacing it with a filling, either an amalgam filling which is the most widely used restorative material for dental fillings or one of the newer types of tooth –colored composite fillings. The choice of filling materials depends on the location of surface(s) to be repaired, how cooperative the Patient is and several other factors (Summitt *et al*., 2001) . Dental amalgam fillings contain mercury and other metals. Because mercury has long been recognized as poisonous to humans, concerns about the potential of mercury poisoning from dental amalgams have been addressed by abundant research. Most scientific studies find no relationship between amalgam fillings and symptoms of mercury poisoning in any age group, although a small number of people have allergic reactions to these fillings (Enestroms and Httman;1995) Research continues in order to expand knowledge

about any potential effects of amalgam fillings on certain populations, particularly fetuses, breast-fed infants, and very young children **(**Melchert ***et al*.** **,** 2008) Even if dental amalgam has provided excellent clinical service for many years and there are only extremely rare cases of documented adverse effect**(**Mjor,*et al* . ,2007**)** and fillings are widely used because they are strong and so provide durable chewing surfaces. They can be inserted more quickly than some other types of fillings, making them useful when treating children. They are less expensive to place than other types of fillings and they usually last longer (Soncini *et al.* ,2007). Mercury is a naturally occurring substance found in earth, water, and air. Most people have measurable but small amounts of mercury in their bodies**(**Summitt *et al.* ,2001)The main concern, related to releasing mercury from amalgam in the saliva is: The potential toxic effects of mercury and the possibility of metallic mercury vapor, as opposed to the small amounts released from amalgam fillings, has occurred as a result of unprotected occupational exposure, school children handling and bringing home quantities of liquid mercury, broken medical devices, folk remedies, and use during religious or magical ceremonies.(Mjor *et al.* , 2007) . National and international bodies have determined that the use of mercury-containing dental amalgams is safe. The World Health Organization stated that "dental amalgam restorations are considered safe…", though the document goes on to note that there are instances of local allergic reactions or side effects. (WHO',1991) . Fung and Molvar found in(1992) that there is no evidence for mercury-related health effects in dental patients, though they noted that a small number of people have true allergies to amalgam

components. Another report by Chey and Buchanan (2008) noted that "there currently is no scientific evidence that supports the association between amalgam mercury exposure and adverse health effects in adults or children. Finally a review of scientific evidence, accumulated over decades, supports the view that mercury may induce adverse immunological effects with regard to the latter, there have been a number of reports suggesting the amalgam fillings may induce oral lichen planus or oral lichenoid lesions and decreasing the antioxidant activity of saliva **(**Bolewska *et al.* ,1990) Moreover allergy to mercury is an exception which affects a small number of people and no Studies supported by any statistical significant association between the presence of dental amalgam and disease (WHO; 1978, WHO; 1991)

Materials and Methods

The study was carried out during October 2011-June-2012 according to a pilot study which depended upon 67 volunteers (46male and 21 female), they have various amalgam fillings, their ages were between 30 to 40 years Persons who had been taking medicine containing Mercury,. and those who had fish consumption which contain high levels of Hg(such as marlin, tuna, shark, swordfish, king mackerel, tile fish, northem pike and lake trout)(Kidd and Batchelark; 2011) which had been more than twice per month were excluded from this study.

After adult consent, they had be fasting for at least 2 hours before saliva collection; each person gave two cup and asked to collect 2-3 ml saliva in the first cup before chew chewing gum, and then the asked to chew sugar free chewing gum for 10 min and then 5 ml of saliva were collected again in the second cup. The informed consent was obtained from all persons at the beginning of the study. Furthermore 5ml of saliva was collected by spitting method in a special prepared tube as suggested by Atomic Energy Organization, and kept in freezer at -18 to-20˚C .(This was performed for prevention of probability absorption of Mercury by the glass wall).Volunteer should not eat anything or brush their teeth at least one hour prior to the second sampling . For measurement of mercury in saliva, the cups containing saliva were transferred to chemical laboratory of Atomic Energy Organization in frozen form and the amount of mercury (after melting the sample)was measured by Atomic absorption spectrophotometer, the flameless AAS was used in this study (Shimadzu AA-670) , With mercury vaporizer unit (MVU-IA) Parameters for mercury detection.

Each saliva sample kept in a volumetric flask

The following reagent was added to it:

HNo_3 or 0.1N H_2So_4 for oxidation

$KMnO_4$ to help the reduction of mercury.

$SnCl_2$ for reduction of mercury ions to metallic mercury vapor as shown in the following equations:

$$Hg + HNo_3 + KMnO_4 \rightarrow Hg^{+2}$$

$$SnCl_2 \leftrightarrow Sn^{+2} + Cl^{-}$$

$$Hg^{+2} + Sn^{+2} \leftrightarrow Sn^{+4} + Hg0$$

The reluctant ($SnCl_2$) was dispensed into the sample solution where it reacts to liberate Cl^- and Hg^{+2} ions were reduced to the metallic state Hg0, and since mercury has an appreciable volatility even at ambient temperature metallic

mercury vapor is driven out of the sample by $SnCl^-$ and transported to the quartz cell, where the resonance beam passed through the Hg vapor and its atomic absorption is measured. In the laboratory of Atomic Energy Organization, after melting the samples and selection of suitable volume of saliva, the amount of Mercury was measured by cold vapor atomic absorption spectrometry (CVAAS). Mercury concentration of amalgam filling of three group's samples was measured.

Results and Discussion

The numbers of volunteers participating in this study were 67 persons (46 males and 21 females) with Mean and standard deviation of age, height and weight of each group as shown in table (**1),** these were general informations about study samples and there were no relation between Mercury concentration in their saliva, the Means value and standard deviation only to indicate the body mass index information. Furthermore , table (2) illustrated the mean and standard deviation of each group of volunteers according to the number of fillings present in their teeth , the concentration of Hg in the first group having one filling was 3.644 ug/L mercury and the concentration of Hg in the second group was7.421 ug/L, while the concentration of Hg in the third group reach to 21.290 ug/L Statistical analysis of the data by using one way analysis of variance (ANOVA) was performed. The results showed that there was significant differences between the three groups, as shown in table **(3**), the one way Anova used to compare the means of three groups sample and the F-value was 166.22 and when compared with the critical value in the level of 0.05 with degree of freedom (2- 64) which was 3.15 showed that F-value was higher than critical value and this fact showed that there were significant differences between the three samples and specially for the third group sample with three amalgam fillings.

Amalgam was the most widely used dental restorative material however; the safety for its use is questionable, due to probability for release of the mercury (Soncini *et al.* ,2007)Many researchers tried to determine the Mercury quantity in blood, urine, saliva, hair and nail. However, unfortunately, the normal level of saliva Mercury amount has not been mentioned in guideline principles of WHO, The range of mercury exposure levels found in people with amalgam fillings by the World Health Organization Scientific Panel on mercury was 3 to 70 micrograms per day and concluded that a safe level of mercury exposure below which no adverse effects occur has never established. (Mjor,*et al*. ,2007) Leistevuo and his colleagues in (2001) compared individuals with or without amalgam, and reported that the amalgam fillings might be continuous resources of organic Mercury which is more poisoned than inorganic Mercury and the organic Mercury is fully absorbed by the human intestine, Pizzichini and his colleagues in (2002) have observed a significant relation between Mercury and number of amalgam restorations or the total surfaces of amalgam either in women or men. The significant contributions of the present research work is to determine relationships among a groups of volunteers having different number of amalgam fillings with different ages and sex and the study found there are significant different between the three groups , moreover the advantage of the present study is that it allows direct estimation of the amount

Table (1) Characterizations of Volunteers, (Age, Height and Weight) with One, Two and Three Amalgam Filling

Group	No.	Age in year Mean ± SD	Height in (cm) Mean ± SD	Weight in (kg) Mean ± SD
G1 (one filling)	25	33.98 ±12.21	168.12 ± 5.51	73.56 ± 7.98
G2 (two filling)	20	35.10 ± 5.92	170.05 ± 4.97	73.7 ± 12.16
G3 (three filling	22	38.08 ± 11.80	170.45 ± 10.45	73.95 ± 13.97

Table (2) The Mean and standard Deviation saliva of Hg concentration in saliva olunteers having different amalgam filling (M±SD)

Group	No.	Mean(Hg µg/L	Std . Deviation
Three filling	22	21.2900	5.45398
Two filling	20	7.4210	2.04172
One filling	25	3.6444	1.47007
Total	67		

Table (3) One Way Analysis of Variance (ANOVA)

	Sum of Squares	df	Mean Square	F	Sig
Between Groups	8925.626	2	1962.8	166.22	.000
Within Groups	755.734	64	11.808		
Total	4681.360	66			

of the Hg specifically released from amalgams and it should be noted however that the proportion of Hg attached to chewing gum per Hg released from dental filling is unknown, hence these data should be regarded as lower limits for Hg release.

The strong dependency between the amount of Mercury extracted from dental amalgams by chewing gum and the number of amalgams present nicely illustrates the validity of this test as a model for Mercury release during food consumption, Dentist should bear in mind that there will be an increasing amount of concern in the future and they should be prepared to answer difficult questions and provide alternative restoration like light cure filling.

In studies of Pizzichini and his colleagues (2002) a considerable correlation has been existed between the saliva Mercury with the quantity of amalgam filling and general size of amalgam and general size of the amalgam surface. Dental amalgam has been widely used for many years, Nevertheless, in several countries its use is declining due to concerns over its safety and environmental pollution. Patient receiving an amalgam restoration is exposed to fairly high doses of mercury

during restoration placement, polishing and replacement, over the years a small continuous dose occurs due to amalgam corrosion products being released (Leistevuo *etal* . , 2001) The Mercury can be solved in saliva in the form of vapor from the materials of the amalgam corrosion or mercury free particles (WHO;1991),

The amount of Mercury in the saliva in our studied group has been increased significantly after fillings. So, it can be resulted that amalgam filling may as an important resource for releasing the Mercury to the saliva and such Mercury can be absorbed systematically upon swallowing and to be concentrated in the body tissues.

It is obviously necessary to do comprehensive research to reply the questions such as, safety of amalgam consumption, deterring the normal amount of saliva with systemic absorption and amount of Mercury, general activity of saliva antioxidants and changes of oral microbial flux, in different periods after amalgam fillings.

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