Bull. Group. Int. Rech. Sci. Stomatol. Odontol. 42, 88-93, 2000

SALIVARY MERCURY LEVELS IN HEALTHY DONORS WITH AND WITHOUT AMALGAM FILLINGS

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KEY WORDS: saliva, mercury, amalgam fillings
MOTS CLES: salive, mercure, amalgame

ABSTRACT

Dental amalgam (AMG) is the most diffused dental filling material. Since it is constituted for at least 40-45% of Hg, many questions have raised about its safe use. Hg particles from dental amalgam dissolve in saliva and, being ingested, they reach the blood stream through the intestinal mucosa. It has been demonstrated that amalgam fillings continuously release Hg vapour and that there is detectable Hg in expired and inspired air of amalgam owners. It is not yet fully accepted that AMG fillings represent the principal source of Hg for man and the aim of this study was to evaluate if the mercury level in saliva: 1) was higher within people bearing dental amalgam restorations than in people with no restorations; 2) was different between males or females; 3) increased in relation to the surface of amalgam restorations. The results showed a correlation between number of fillings and salivary Hg, between amalgam surface and salivary Hg. The Authors could finally assert that AMG fillings represented the principal source of salivary Hg in the subjects studied.

RESUME

Il a été démontré que les obturations en amalgame libèrent continuellement des vapeurs de mercure,que ce dernier se dissout dans la salive avant d'être ingéré ou inhalé. En effet, on a relevé des concentrations de Hg dans l'air inspiré par les sujets porteurs d'obturations en amalgame. Il n'est pas encore reconnu universellement que l'amalgame dentaire représente la principale source de Hg pour l'homme non exposé pour des raisons professionnelles. Le but de cette étude est d'évaluer les niveaux de mercure dans la salive des sujets porteurs et non porteurs d'amalgame, de les corréler au nombre d'obturations en amalgame et à l'ampleur des obturations. Les auteurs concluent, enfin, que les obturations en amalgame constituent la première source de Hg pour les sujets examinés.

INTRODUCTION

Dental amalgam is a durable and inexpensive material used in restorative dentistry for the population of many countries.

The potential effects of mercury and amalgam on both patients and personnel in the dental profession have raised serious questions about its use. Elemental mercury makes up 50% of dental amalgam by weight, it can be released as Hg vapor, absorbed across the pulmonary epithelium or ingested into the gastro-intestinal tract. Oral or intestinal bacteria are able to transform elemental Hg in inorganic form, then in organic form especially methylmercury (Me-Hg), the most toxic, which can be accumulate in several organs including the central nervous system and kidneys.

It is generally believed that people is primarily exposed to Me-Hg from fish consumption (Bergdahl et al., 1998) and that, after food, amalgam fillings constitute the main source of exposure to mercury for the general population (WHO, 1990; WHO, 1991).

Many studies of mercury levels in expired air (Langworth et al., 1997; Svare et al., 1981), urine (Begerow et al., 1994; Sandborgh-Englund et al., 1998), blood (Sandborgh-Englund et al., 1998; Molin et al., 1990), saliva (Bjorkman et al., 1997; Berglund, 1990; Ahmad and Stannard, 1990) indicated that there was a positive correlation between the presence of amalgam restoration and mercury levels. Variations in pH, time, temperature, chewing, brushing, cyclic loading,

corrosion process have clearly shown an influence on Hg release (Marek, 1997; Berdouses et al., 1995).

The purpose of the study reported here was to evaluate if the mercury level in saliva: 1) was higher within people bearing dental amalgam restorations than in people with no restorations; 2) was different between males or females; 3) increased in relation to the surface of amalgam restorations. Furthermore, no recent data are available regarding salivary Hg in healthy italian donors.

MATERIAL AND METHODS

Sixty-four young healthy donors (35 males, 29 females; 18-22 year old, mean 20±1.18) were chosen to participate in this study and all gave their informed consent.

The subjects were asked not to eat or drink for 1 hour prior to the collection of a saliva sample, which was performed between 9 and 12 a.m.

Collection of saliva sample.

All subjects were asked to rinse their mouth five times with distilled water, to rinse with the saliva produced in order to remove the excess of water from oral tissues and to swallow during a 5 min interval, to collect the newly produced saliva in the mouth for 5 min and then to deposit the saliva in a test tube. Samples containing 1- 1.5 ml were stored at -80° C until utilized. The examination included a data collection and an inspection of the teeth by a dentist.

Amalgam surfaces.

An amalgam score was calculated yielding a score of 1 when the amalgam surface had a diameter of 1 mm or less, 2 if it was above 1 and less than 2 mm, 3 if it was 3 mm or less and 5 if it was more than 3 mm. The amalgam score is the summation of the scores of all the amalgam surfaces on all the teeth of each subject.

Hg determination.

Cold vapor atomic absorption spectrometry (Perkin Elmer FIMS 400 - Flow Injection Mercury System) was used to determine the total Hg. Saliva samples (1 ml) were digested with 3ml of concentrated nitric acid (Merck Suprapur, Merck KgaA, Frankfurter Strasse 250, Darmstadt) in Teflon vessels under pressure at 120°C for 8h (Chien et al., 1996; Drexler and Schaller, 1998). Each series of analyses was accompanied by concurrent mineralization and identification of Standard Reference Materials (SRMs) no. 1577b "Bovine Liver" from NIST Gaithersburg, USA). Batches with accompanying SRMs outside the certified range were repeated. The reliability of Hg determination, expressed as the coefficient of variation on repeated assays of the same sample, was below 5%.

Statistical Analysis

A simple regression analysis was used to compare the experimental results, separately for females and males. Only p values < 0.05 were considered as significant.

RESULTS

The results for total Hg in saliva are reported in Table 1, with a separation between males and females. Seven subjects (2 males and 5 females) had a detectable Hg level without amalgam restoration, and only one subject showed 0 value with one amalgam restoration. Except these cases, all results indicated detectable Hg values in saliva.

A stronger correlation was found in males between Hg levels and number of restorations (Fig. 1, R=0.831 p

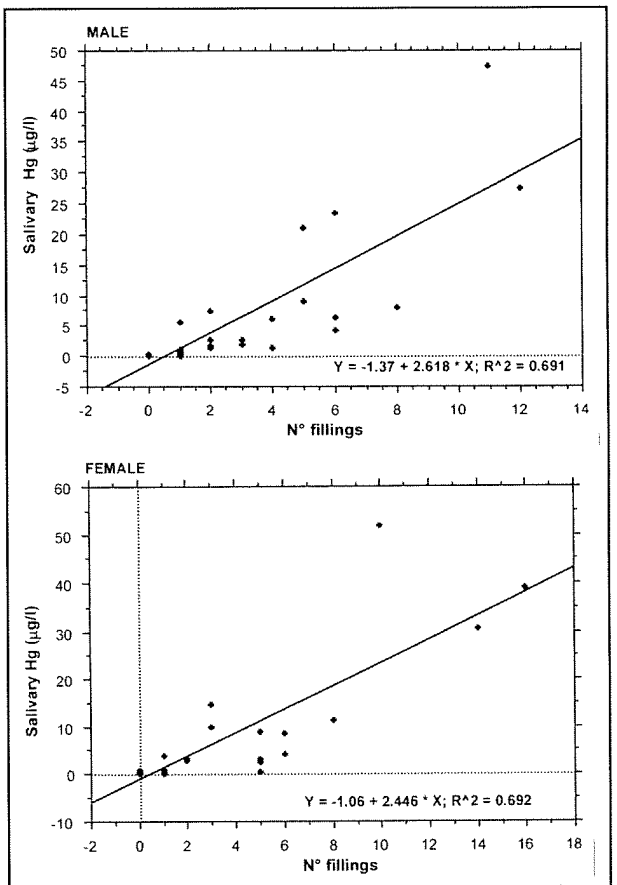

Fig. 1: Correlation between salivary Hg and number of amalgam fillings.

< 0.0001) and amalgam score (Fig. 1, R=0.697, p < 0.001).

The same correlation was reported in females between Hg levels and number of restorations (Fig. 2, R=0.832 p < 0.0001) and amalgam surface (Fig. 2, R=0.859 p < 0.0001).

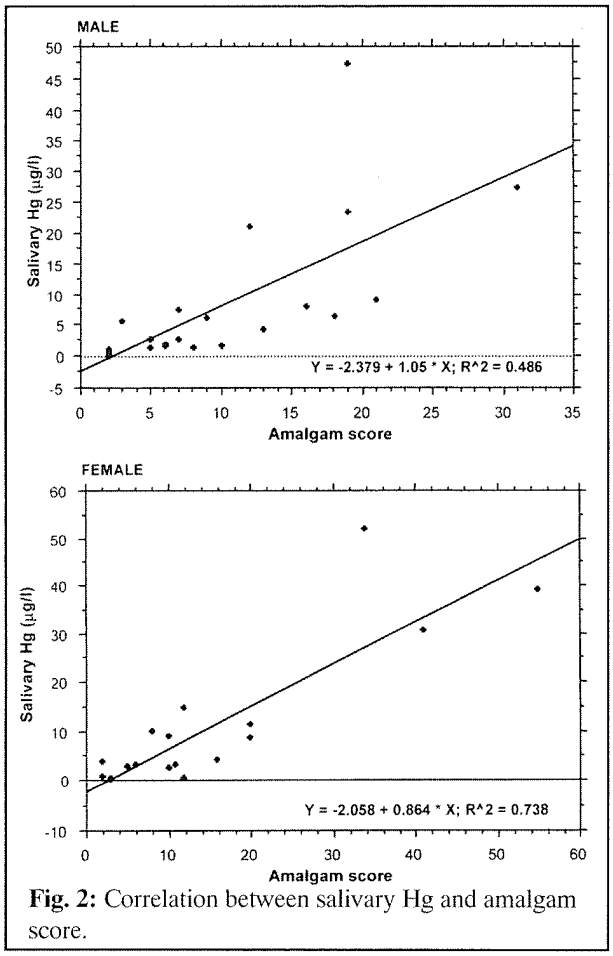

Fig. 2: Correlation between salivary Hg and amalgam score.

DISCUSSION

The presence of Hg in saliva could result from different processes. It has been postulated that mercury vapor released from dental amalgam was not the major source of Hg in saliva, since it decrease steadily for 2 weeks after total amalgam removal. Willerhausen-Zönnchen et al. (1992) found detectable Hg in oral mucosa and Ekstrand et al. (1998) suggested that desquamated oral epithelial cells and plaque could constitute an important source of salivary Hg. We believe that the protocol we used to collect saliva samples could minimize these influences. In fact, for a total interval of 10 min the subjects rinsed their mouth first with distilled water and then with their own saliva, reducing the number of circulating desquamated cells and removing the more superficial plaque. Based on these considerations, we may deduce that the Hg we detect in saliva is mostly excreted through the salivary glands.

A remarkable outcome to underline was that subjects without amalgam fillings had no Hg in saliva, except of 2 males and 5 females who presented low levels of Hg. In these subjects, it was not possible to identify the origin of that Hg, even though food and water or environmental contamination could be postulated as responsible. It is known, in fact, that fish consumption is considered an important source of MeHg for general population (Bergdahl et al., 1998). Only one subject with one filling had 0 Hg in saliva. In this case, the small amalgam surface of exposure (i.e. amalgam score=2), probably in a good state without fractures or porosity, could explain that result.

A highly significant direct correlation between Hg and number of fillings or amalgam score both in males as in females clearly appear in Figs. 1-2. Based on the obtained results we can deduce that Hg from dental amalgam is the principal source of salivary Hg in the examined subjects. This evidence does not fully agree with most of the current literature. Many Authors assert that food represent the greatest exposition to Hg. Perhaps dietary habits in this particular area of the countryside of Tuscany where fish consumption is low, could explain our results. This represent a further controversial aspect about dental amalgam and another matter which states reason for a more and more careful examination of the question about Hg from dental restorations for the debated consequent adverse effects on human body (Bratel et al., 1997; Syblerud et al., 1994; Uzzel and Oler, 1986; Berglund and Molin, 1996).

At the same number of amalgam fillings (Table 1) correspond highly different levels of Hg in saliva. Our data confirm what many Authors have previously demonstrated: the type of amalgam (g2 and not g2), the age of the restoration and the level of exposed surface corrosion can influence the release of Hg. Some habits, as well, like bruxism (Isacsson et al., 1997), brushing and chewing, for example, determine an additional abrasion of the amalgam surface, a consequent release of amalgam particle in saliva and in expired air and an exposition of a "new" surface which could be rapidly

oxidized. Also the presence of metallic crown or other prosthetic device could determine galvanic currents that improve the dissolution of amalgam particles.

On the base of these considerations, when a dentist is asked to remove some amalgam fillings from patients who refer their illness to them, we believe he should carefully check not only the real conditions of the restorations, the functional efficiency of them, but also the mercury level in saliva, blood and urine to assess the eventual risk for the health of the patient. He should also act according all the available techniques in order to reduce the Hg exposition of the patients during the removal. It has been previously clearly demonstrated that rubber dam, high speed evacuation and cooled drilling can significantly reduce the otherwise inevitable increment of Hg in plasma and urine after amalgam removal (Berglund and Molin, 1997; Kremers et al., 1999).

Even because, despite the always increasing number of new data about this topic, the burning debate about dental amalgam and health risk seems still far to be solved.

N° amalgam restoration	Salivary Hg	Amalgam Score
0	0	
0	0	
0	0	
0	0.42	
0	0	
0	0	
0	0	
0	0	
0	0.14	
0	0	
0	0	
0	0	
0	0	
0	0.73	
0	0	
0	0	
0	0.73	
0	0	
0	0.64	
0	0	
0	0	
0	0	
0	0.13	
0	0.81	
1	0.73	2
1	0	2
1	5.62	3
1	0.37	2
1	1.06	2
1	3.93	2
1	0.71	2
1	0.57	3
1	0.15	3
2	1.53	10
2	1.47	5
2	7.43	7
2	2.77	5
2	1.64	6
2	3.17	6
2	2.96	5
3	1.97	6
3	2.59	7
3	9.83	8
3	14.76	12
4	1.48	8
4	6.22	9
5	21.02	12
5	8.99	21
5	0.41	12
5	2.47	10
5	8.79	10
5	3.12	11
6	23.33	19
6	4.35	13
6	6.55	18
6	8.67	20
6	4.08	16
8	8.15	16
8	11.14	20
10	51.91	34
11	47.24	19
12	27.4	31
14	30.43	41
16	39.09	55

Tab. 1: Number of amalgam restorations, salivary Hg and amalgam score in all examined subjects.

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