Removal of mercury contamination from the dental clinic with metal backing for X-ray film

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ABSTRACT

Background: Mercury in dental clinic has been recognized as a potential health hazard. This evaluated the removal of Hg spills from different surface in dental clinic with tin in the metal backing for dental x-ray film.

Materials and Methods: Hg 90 drops (each one of 0.2 g) placed on 9 different surfaces in the dental clinic, and were divided into: Group I (protective surfaces) subgroup 1 (mask) subgroup 2 (gloves) subgroup 3 (dental apron) Group II (dental instrument and equipment) subgroup 1 (metals, for example, the metal tray of sterilizer) subgroup 2 (dental chair unit) subgroup 3 (wet surfaces, for example, the vacuum suction tank of the sucker). Group III (other clinical surfaces) subgroup 1 (working bench) subgroup 2 (the floor) subgroup 3 (the carpet). The metal backing for x-ray film (0.4 g) placed on each Hg spill, and the time of adsorption was recorded in seconds using a digital timer.

Results: The results showed adsorption of Hg spills to the metal backing for x-ray film in all groups except in the crevice of the carpet. Group I subgroup 2 showed the faster interaction (7.1 + 2.828 sec.) while group II subgroup 3 showed the slowest interaction (90.3 + 20.981 sec.).

Conclusion: Hg spills on dental protective surfaces can be removed easily, while the most difficult spills to be removed were on the wet surface. Furthermore, Hg spills in crevis of the carpet can not be removed.

Keywords: Mercury, metal backing, x-ray film. **(J Coll Dentistry 2005; 17(2): 24-27)**

INTRODUCTION

Amalgam has been used for 150 years and about 200 million amalgams are inserted each year in the United States and Europe, although periodically, concern arises about the mercury toxicity. [1,2]

As vapors mercury is odorless and colorless and has a high vapor pressure, these combinations make Hg a potentially serious inhalation hazard if not managed properly. [3] [4,5]. *

Exposure to Hg in dental clinic has been recognized as a potential health hazard to patient and dental personnel for many years. [6] The dental office personnel are at greater risk to mercury vapor and therefore mercury vapor and therefore mercury toxicity. [1] The sources of Hg hazard in dental clinic include:

Some Hg vapor released from stored materials.

Small losses from capsules during tituration

Spillage during manipulation for cavity restorations

Some vapor exposure to dentist, assistant and patient during removal, placement, finishing and/or polishing of dental amalgam.

Contamination of cotton rolls.

Collection of debris via vacuum suction into plumbing system and sewage system.

Collection of remnants in jar for recycling

Hg that is trapped in small cracks between floor tiles and/or in carpet fibers.

Hg vaporization from contaminated instruments placed in sterilizer. [5,7]

Exposure to Hg can occur either through direct skin contact with Hg or Hg-containing compounds or through the inhalation of Hg vapor [7]. The inhalation of Hg vapor is the primary route of exposure. [8]

Furthermore, Ferracane et al investigated exposure to elemental Hg vapor from Hg spills in the dental office. They concluded that Hg remained in vapor form for only limited periods, because of its density and affinity for surfaces, and that a single accidental Hg spill probably would not be the only significant source of Hg in dental clinic. [9]

Mercury combines readily to form amalgam with several metals such as gold, sliver, and copper, tin and zinc. [1] Johnson in 1967 reported that a mixture of tin powder and 18.5% mercury is completely amalgamated within two minute. This observation led to the idea that tin in the metal backing for dental x-ray film is an excellent material for removing mercury that has been spilled.[10]

The aim of this study was to evaluate the removal of mercury spills from different surfaces in dental clinic with tin in the metal backing for x-ray film.

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MATERIALS AND METHODS

This study was done in the author's private dental clinic. Mercury spills were simulated by placing 90 drops of Hg-each one of 0.2g (Mercure, Septodent, France)-on 9 different surfaces in the clinic.

According to the types of surfaces, the drops were divided into 3 groups. Each group had been subdivided into 3 subgroups each one contained 10 drops.

Group I (protective surfaces)
- Subgroup 1 (dental mask)
- Subgroup 2 (gloves)
- Subgroup 3 (dental apron)

Group II (dental instrument and equipment)
- Subgroup 1 (metals, for example the metal tray of the sterilizer)
- Subgroup 2 (the dental chair unit)
- Subgroup 3 (the wet surface, for example the vacum suction tank of the sucker).

Group III (other clinical surfaces)
- Subgroup 1 (working bench)
- Subgroup 2 (the floor)
- Subgroup 3 (the carpet)

The interaction of mercury and tin in the metal backing for x-ray film was studied by using 45 sheets of metal backing for dental x-ray film, each one (0.8 g) divided into two pieces, each piece (0.4 g) was bent (in 45^{o}bend) to facilitate its application and removal, then it was held in one hand (Figure 1) while a digital timer was held in the other hand. The time interval between the application of tin and adsorption of mercury was recorded in seconds. (Figure 2)

The data obtained was subjected to analysis of variance (ANOVA) test and least significant difference (LSD) test.

RESULTS

All the Hg spills were adsorbed to the metal backing for x-ray film except those placed in the crevis of the carpet, so they were disregarded and replaced with another spills placed on the superficial surface of the carpet.

The mean values and standard deviations are presented in table 1 and figure3.

It is clearly obvious that the adsorption of Hg to the metal backing for x-ray film was faster when placed on dental gloves, while it was slower when placed on the wet surface.

Table 1: the means values and standard deviation for the time of adsorption (of Hg to the metal backing for x-ray film) in seconds.

Subgroup	Mean values + standard deviation		
	Group I	Group II	Group III
1	9 ± 1.64	40.1± 4.8	24.5 ±4.8
2	7.1 ± 2.8	25 ± 4.4	34.9 ± 4.3
3	12.8±2.8	90 ± 20.98	35.8 ± 4.9

Figure 1: Application of metal backing for x-ray film on Hg spill placed on the superficial surface of the carpet

The statistical analysis of the data using ANOVA test indicated very highly significant difference at $P< 0.01$ level. The source of differences was investigated using LSD test. The statistical analysis of the data using LSD test showed:

There were no significant differences between:
- All subgroups of group I (protective surfaces).
- Group II subgroup 2 (dental chair) vs. Group III subgroup 2 (floor).
- Group II subgroup I (metal surfaces) vs. Group III subgroup 2 (floor)
- Group III subgroup 2 (floor) vs. Group III subgroup 3 (superficial surface of the carpet)

There were statistical significant differences (LSD 0.5=8.559) between:
- Group II subgroup 1 (metal surfaces) vs. Group II subgroup 2 (dental chair)
- Group III subgroup I (working bench) vs. Group III subgroup 2 (floor).
- Group II subgroup 1 (metal surfaces) vs. All subgroups of group I.

- Group II subgroup 2 (dental chair) vs. All subgroups of group I.
- All subgroups of group I vs. All subgroup of Group III.
- Group II subgroup 2 (dental chair) vs. group III subgroup 2 (floor)
- Group II subgroup 1 (metal surfaces) vs. group III subgroup 1 (working bench).

There were highly significant differences (LSD 0.05 = 25.161) between:
- Group II subgroup I (metal surfaces) vs. All subgroup I.

There were very highly significant differences (LSD 0.01=33.338) between.
- Group II subgroup 3 (wet surfaces) vs. All the other subgroups.

DISCUSSION

Exposure to Hg in dental clinic has been recognized as a potential health hazard to patient and dental personnel for many years. [5] Ferracane et al concluded that concluded that Hg remained in vapor for only limited period, because of its density and affinity for surfaces. [9] Grayower et al prescribed the metal backing for x-ray film as an excellent material for removing Hg spills. [11]

In this study, the interaction of tin in the metal backing for x-ray film with Hg spills on different surfaces of dental clinic had been investigated. The results showed a clear difference in time of interaction between Hg spills and the tin in the metal backing for dental x-ray film. These findings attributed to the differences in surfaces. Every surface has a surface energy differs from the other. The spreading of Hg to any surface is a result of balance between the interfacial energies. The difference in spreading of Hg spills resulted in differences in the surface area in contact with the metal backing for x-ray film. This mechanical contact required to rupture the oxide layer that covers the metal backing for x-ray film. This oxide layer prevents the reaction of tin with Hg.

Group I (protective surfaces) the Hg spills showed spreading to these surfaces, therefore a large surface area of Hg spills were in contact with the metal backing for x-ray film and resulted in the faster interaction.

Group II (dental) instrument and equipment). The Hg spills showed less spreading to these surfaces. In group II subgroup3 (wet surfaces) the water affect the mechanical contact between the Hg spills and the metal backing for x-ray film, thus resulted in the slowest interaction (90.3 + 20.981 sec.)

Group III (other clinical surfaces), the Hg spills spreading was less than in group I and a slower interactions were recorded. Furthermore, the interaction of Hg spills with tin in the metal backing for x-ray film was faster than in group II subgroup 3 (wet surface) since there was no water to affect the mechanical contact between the Hg spills and the metal backing for x-ray film. This mechanical contact was absent in group III subgroup 3 (the crevis of the carpet) therefore the Hg spills didn't adsorb to the metal backing for x-ray film.

Clinical Implication
- Dental protective surfaces (gloves, dental mask and dental apron) are very effective in preventing occupational hazard with Hg, since Hg showed affinity to these surfaces, but they should be changed or decontaminated frequently.
- It is better to dry a wet surface before being decontaminated.
- It is better to avoid carpeting in the dental clinical.

Figure 2: Adsorption of Hg spill to the metal backing for x-ray film.

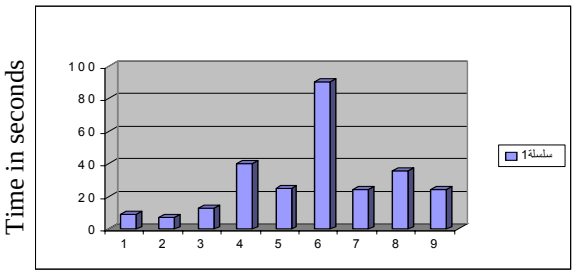

Figure 3: Bar chart shows the differences in means between groups and subgroups

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