Review Article

Mercury Allergy and Toxicity: A Possible Occupational Hazard of Dentistry

SZ Mahmud[1], MM Uddin [2], A Rahman[3], MA Samad [4], NA Nomann[5]

Abstract

Amalgam mix along with mercury is being used successfully for over 150 years, primarily due to its highly admirable ability to withstand the harsh oral environment and being one of the least technique-sensitive restorative materials. During the past 10 years questions have been raised about possible health risks associated with use of dental amalgam, the traditional method of restorations of carious cavities in posterior teeth. It was conspicuous that the alleged dangers of mercury toxicity/allergy achieved sudden publicity when a new and expensive composite restorative material was introduced. Nevertheless, many dentists have had decades of exposure to mercury and absorbed significant amounts but do not appear to have been significantly harmed. In fact, there is insufficient evidence to justify claims that mercury from amalgam restorations has an adverse effect on the health of the patients. The purpose of this article is to review briefly and critically the scientific evidence on mercury release from dental amalgam, the possible occupational hazards as well as effective recommendations are made to ensure safe handling and usage of dental amalgam.

Key words: *Amalgam filling, hypersensitivity, mercury toxicity, mercury vapour, occupational hazard.*

Introduction

In carrying out their professional work, dentists are exposed to a number of occupational hazards. These cause the appearance of various ailments, specific to the profession, which develop and intensify with years. In many cases they result in diseases and disease complexes, some of which are regarded as occupational illnesses.[1] Many materials commonly used in dentistry today are considered toxic and harmful to health. Among those materials are the base metal mercury, nickel, lead, chromium, cobalt, beryllium, zinc, tin, copper, and many others. Dentists also apply sterilizing agents such as phenol, formocresol and chlorine directly into root canals. All of the phenols and most of the halogens are considered toxic to some degree. This profession has a long history with regard to the use of mercury.[2] During the past 10 years questions have been raised about possible health risks associated with use of dental amalgam, the traditional method of restorations of carious cavities in posterior teeth. The issue has occasionally received negative media attention, resulting in considerable public anxiety about the possible toxic effects of slow leakage of small amounts of mercury from amalgam fillings.[3] Amalgam mix along with mercury is being used successfully for over 150 years, primarily due to its highly admirable ability to withstand the harsh oral environment and being one of the least technique-sensitive restorative materials. In addition, it is of a high-strength, durable, dimensionally stable and reasonably cheap, the fact that kept most dentists still more familiar with amalgam than with any other direct posterior restorative material.[4]

The dangers of mercury are either from systemic absorption, particularly of organic mercury compounds such as methyl mercury, or from the development of hypersensitivity (contact dermatitis).

1. Dr. Shaikh Zakir Mahmud BDS, MPH, Medical Officer (Dental Surgeon), National Healthcare Network (NHN) Mirpur Centre, Dhaka, Bangladesh

2. Dr. (Lt. Col) Mohammad Mesbah Uddin BDS, Chief Consultant, Saba Dental Care, DOHS Baridhara, Dhaka, Bangladesh

3. Dr. Ataur Rahman MBBS, DCH, Consultant & Hospital Director, Ibrahim General Hospital-Mirpur, Dhaka, Bangladesh

4. Dr. M A Samad MBBS, DEM, Consultant & Chief Executive Officer, National Healthcare Network (NHN), Dhaka, Bangladesh

5. Dr. Nahid Al Nomann BDS, Doctoral Fellow, Division of Clinical Cariology & Endodontology, Department of Oral Rehabilitation, School of Dentistry
Health Science University of Hokkaido, Japan

Address of Correspondence:
Dr. Shaikh Zakir Mahmud BDS, MPH, Medical Officer (Dental Surgeon), NHN Mirpur Centre, An Enterprise of the Diabetic Association of Bangladesh, Commercial Plot No. 27-28, Block-Kha, Main Road-1, Section-6, Mirpur, Dhaka-1216, Bangladesh.
E-mail: suman79_bd@yahoo.com

Mercury intoxication is frequently confused with allergy by the public and the media.[5] The dental amalgam controversy refers to the conflicting views over the use of amalgam as a filling material mainly because it contains the element - mercury. Scientists agree that dental amalgam fillings leach mercury into the mouth, but studies vary widely in the amount and whether such amount presents significant health risks. Estimations run from 1-3 micrograms (μg) per day up to 27 μg/day. The effects of that amount of exposure are also disputed, and currently dental amalgam is approved for use in most countries, although Norway, Denmark, and Sweden are notable exceptions.[6]

Composition of Amalgam Alloy

Composition of currently used alloy is silver 40–70%, tin 12–30% and copper 12–24%. It may also include indium 0–4%, palladium 0.5% and zinc up to 1%. Zinc prevents the oxidation of other metals in the alloy during manufacturing process. Zinc also inhibits corrosion. Some researchers believe that if zinc containing amalgam is contaminated with moisture, it causes delayed expansion. Indium containing admixed high-copper amalgam exhibited a reduction in creep and increase in strength. Youdelis also found that less mercury is required for mixing amalgam when it contains indium in concentration up to 10%. The reason for lower mercury emission is that amalgam prepared with indium rapidly forms indium oxide and tin oxide films which reduce mercury release. Palladium reduces tarnish and corrosion.[7]

Exposure to Mercury

Hypersensitivity to mercury or its salts causes an inflammatory and sometimes vesiculating reaction when it is in contact with skin. This can readily be confirmed by patch testing, but even those with proven sensitivity can tolerate mercury amalgams in the mouth. Nevertheless, in practical terms it is usually simpler to use composite materials to obviate the precautions necessary to prevent mercury coming into contact with their skin. If a dentist develops sensitivity, gloving and covering the arms (as required for infection control) should provide adequate protection during preparation and insertion of amalgams.[5] Train all personnel involved in the handling of mercury and dental amalgam regarding the potential hazards of mercury vapor and the necessity of observing good mercury hygiene practices. Remove professional clothing before leaving the workplace.

Work in well-ventilated work areas (dental clinics), with fresh air exchanges and outside exhaust. If the work areas are air-conditioned, the air conditioning filters should be replaced periodically.[8] Although mercury vapor is released from dental amalgam, the quantities are very small and do not cause verifiable adverse effects on human beings.[9] There is no evidence that dentists who are exposed to dental amalgam and vapor on a daily basis get mercury poisoning; however individual dentists and staff members have become mercury poisoned and studies of the dental profession has documented a decline in cognitive abilities greater than the non-mercury exposed individuals. Some studies have indicated that mercury from dental amalgam has mild effects on some dentists.[6]

Systemic Mercury Toxicity

The New England Journal of Medicine notes, 'Many important medical questions concerning mercury toxicity remain to be answered.[10] Systemic mercury toxicity is a possible occupational hazard of dentistry. Mercury and particularly methyl mercury is neurotoxic. To what extent the metal is converted to organic compound in the body is unclear, but care should be taken in handling mercury and preventing it from being split or scattered in particles during amalgam mixing. Drilling out old amalgams also gives off traces of mercury vapor if the bur is poorly cooled. Serious pollution arises from spilling a substantial quantity of mercury, particularly on to carpeted or wooden flooring. Decontamination can then be difficult. Even worse is when (as has happened) a dental surgery assistant spills mercury behind an autoclave but fails to report the accident. As a result of the rapid evaporation, mercury absorption by the dental staff can then rise to alarming levels.[5] The ADA and others have repeatedly pointed out that dentists are exposed to large amounts of mercury both in school during their training and in their profession through the use of this restorative material.[11] In addition, dental amalgam has been ruled a hazardous substance by the U.S. EPA.[12]

Many skeptics maintain that if mercury were as dangerous a poison as numerous medical, environmental, occupational, health, and safety agencies have concluded, then there should be overt symptoms of mercury poisoning in the dental profession. Although that is not a very scientifically valid approach, it appears to be a reasonable hypothesis.

Nevertheless, many dentists have had decades of exposure to mercury and absorbed significant amounts but do not appear to have been significantly harmed. Though mercury and particularly its organic compound are undoubtedly toxic, public anxiety about mercury-containing dental amalgams has been aroused by unscrupulous practitioners, scaremongers and others. It was conspicuous, for example, that the alleged dangers of mercury toxicity ('allergy') achieved sudden publicity when a new and expensive composite restorative material was introduced.[5]

Some studies have shown that the problems patients attribute to amalgam restorations are psychosomatic in nature and have been exacerbated greatly by information from the media or from a dentist.[13-17]

Minute traces of mercury can be absorbed through the oral mucosa from amalgams and may occasionally give rise to mucosal lichenoid reactions. Otherwise there is no convincing evidence that dental amalgams are toxic or the cause of vague symptoms such as poor memory, lassitude and depression, from which most people seem to suffer from time to time. It has also been shown that patients who complain of vague symptoms from 'mercury allergy' tend also to suffer from a variety of complains (such as irritable bowel syndrome) which have no clear organic basis. In one group of 20 patients complaining of amalgam-related symptoms, none was found to be hypersensitive to mercury. It also, incidentally, cannot be shown that alternative materials such as composites, of which there is much less experience, are necessarily safer. Some of them give off traces of formaldehyde, which is suspected of carcinogenicity.[5] One study found that people with symptoms they related to amalgam fillings did not have significant mercury levels. The study compared ten symptomatic patients and eight patients with no reported health complaints. The symptom group had neither a higher estimated daily uptake of inhaled mercury vapor, nor a higher mercury concentration in blood and urine than in the control group. The amounts of mercury detected by the tests were trivial.[18]

Discussion

An extensive review published in 1993 by the U.S. Department of Health and Human Services concluded that, 'there is scant evidence that the health of the vast majority of people with amalgam is compromised or that removing fillings has a beneficial effect on health.[19]

In January 1998, the American Dental Association Council on Scientific Affairs issued a report on dental amalgam safety, with emphasis on studies that had been published since the 1993 review. The report concluded: 'Millions of people have amalgam restorations in their mouths, and millions more will receive amalgam for restoring their carious (decayed) teeth. Over the years, amalgam has been used for dental restorations without evidence of major health problems. Newly developed techniques have demonstrated that minute levels of mercury are released from amalgam restorations, but no health consequences from exposure to such low levels of mercury released from amalgam restorations have been demonstrated. Given the available scientific information and considering the demonstrated benefits of dental amalgams, unless new scientific research dictates otherwise, there currently appears to be no justification for discontinuing the use of dental amalgam.[20]

In Germany it has been estimated that 38 million persons received an amalgam filling.3 Amalgam was used in 53.3% of the direct restorations of posterior teeth in Taiwan.[21] In England and Wales approximately 22 million amalgam restorations are placed each year and 160 millions in USA. If the claims made in the media relating to amalgam were valid, many of these people should exhibit symptoms of mercury toxicity and suffering from a variety of diseases. This is clearly not the case. Rare cases of mercury allergy have been reported (approximately 50 cases since 1906), and more commonly, local soft tissue lesions adjacent to amalgam restorations which completely resolve on removal of amalgam.[4] Components of amalgam may, in rare instances, cause local side effects or allergic reactions referred to as oral lichenoid lesions (OLLs). OLLs to amalgams are recognized as hypersensitivity reactions to low-level mercury exposure. The use of patch testing to identify those susceptible from OLL is explored, and recommendations for removing amalgam fillings, when indicated are outlined.[22] A few patients with multiple sclerosis have been persuaded that their disease had been caused by their amalgams restorations and demanded their replacement. There is no medical justification for so doing, apart from offering the patients some temporary emotional comfort. Despite the high risks of litigation in the USA, the Council on Dental Therapeutics of the American Dental Association has stated that, 'there is insufficient evidence to justify claims that mercury from amalgam restorations has an adverse effect on the health of the patients.[5]

The research literature, involving many retrospective studies, has shown the safety of dental amalgam. In fact, The World Health Organization /Federation Dentaire International (FDI) issued a consensus statement in 1995 that dental amalgam has not been shown to have an adverse health effect. This same report, however, did emphasize that the mercury should be an environmental concern, both within the dental office and when disposing of amalgam waste.[23]

Mercury release from dental amalgam is minimal-estimated to be 10µg/d, whereas the World Health Organization's maximum recommended intake is 2µg/kg/d. Hydrogen peroxide, a common bleaching agent, can increase mercury release, so avoidance should, be considered. Health Canada states that amalgams should not, if possible, be placed or removed during pregnancy, which might be a rather conservative approach, as studies and case reports of amalgam exposure during pregnancy have not documented any toxicity, including birth defects, neurologic sequelae, spontaneous abortions, or reduction in fertility. In a database study, there was no association of cumulative amalgam exposure in 1062 births categorized as having 'complications of pregnancy and childbirth.' A case-control study of 1117 low birth-weight (LBW) infants found no association between LBW and placement of amalgam during pregnancy.[24] Peer-reviewed scientific studies have come to opposite conclusions on whether the mercury exposure from amalgam fillings causes health problems. A 2004 systematic review conducted by the Life Sciences Research Office, whose clients include the FDA and NIH, concluded that 'the current data are insufficient to support an association between mercury release from dental amalgam and the various complaints that have been attributed to this restoration material[6].

From the scientific and clinical point of view, dental amalgam is still considered a safe material for posterior restorations. It is the material of choice for stress-bearing restorations, easy to handle and cost-effective. In continuing to use amalgam, dentists should realize that mercury exposure mainly result from poor mercury hygiene within the dental office as a result of;[25]

• Incorrect storage of mercury or waste amalgam.

• Spillage of mercury or waste amalgam used in dental procedures.

• Inappropriate preparation, placement, removal and polishing of amalgam.

Recommendations

Specific instructions in the disposal and handling of dental amalgam have been given.26-28

• A no-touch technique of handling amalgam should be used. Direct contact or handling of mercury, amalgam, or other mercury-containing materials should be avoided.

• All amalgam scraps should be salvaged and stored in a tightly closed container. They should be covered with a sulfide solution such as X-ray fixer solution.

• Skin exposed to mercury should be washed thoroughly.

• Pre-capsulated alloy should be used, and used capsules resealed.

• Water and high-volume evacuation should always be used, both when removing old fillings and when finishing new restorations.

• Evacuation systems should be passed through filters, strainers, or traps, and not exhausted into the office or directly into the sewer.

• Amalgam waste may be mixed with body fluids, such as saliva, or other potentially infectious material, so use personal protective equipment such as utility gloves, masks, and protective eyewear when handling it.

• Put a rubber dam in patient's mouth to avoid swallowing or inhaling any toxins.

• Recycling all amalgam waste through an appropriate amalgam recycler (including used capsules)

• The dental office should be monitored for mercury vapor once a year or more often if contamination is suspected as well as periodic urine analysis of all dental personnel should be conducted.

Conclusion

The present scientific evidence demonstrated that dental amalgam mixed with mercury does not pose a health hazard. Thus, it can be used safely for posterior restorations. None of the studies support the view that complaints of the patients studied were related to presence or number of amalgam fillings. However, strict mercury hygiene should be exercised to minimize the mercury exposure of staff and patients. Dental professionals are obliged to educate their patients about the debate over mercury toxicity and have to pursue scientific evidence to justify any modification introduced into their clinical practice. Although, the indiscriminate replacement of amalgam restorations, on the basis of alleged toxicity, with any other material is unethical and irrational conduct.

It has to be emphasized that there is no dental restorative material that can be considered as absolute safe under all conditions, for all patients and dental personnel. Paracelsus, in the 16th century, stated 'All substances are poisons. There is none which is not a poison. The right dose differentiates a poison and a remedy[4].

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