The Perturbation Encompassing Dental Amalgam Toxicity: A Review

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Abstract

Amalgam in dentistry has been in use for over 150 years and still been widely used because of its low cost, easy application, durability, bacteriostatic effect, and strength. Whenever aesthetics isn't the prime concern it is possibly used with no age bar, in areas of stress, as a foundation for cast-metals, ceramic restorations, and below-par oral hygiene conditions. Its advantages such as long-lasting and being less technique sensitive among all restorative materials, there has been growing concern about amalgam that it causes mercury toxicity. Mercury (Hg) has been historically popular as one of the extremely toxic nonradioactive materials. Therefore, the present article aims to discuss and assess a brief historical review of literature on its adverse effects, toxicological aspects that have been noted, potential risks relating to the dental personnel's and its safe and effective way of manipulating and handling concerning the use of mercury in dentistry.

Keywords: *mercury; dental amalgam; dentistry; toxicity;*

Introduction

Dental amalgam was used first by the Chinese. Su Kung (659 AD) mentioned the use of a mixture in the Material Medica[1]. A municipal physician in Germany, Europe named Johannes stokers in 1528 recommended amalgam as a restorative material[2]. Dr.Wilmer Eames in 1959 recommended mercury to alloy ratio of1:1, thus lessening the ratio of 8:5 mercury to an alloy that others had previously been recommending[3]. Mercury is present in the environment and thus humans are regularly exposed to it via water, food, and air[4]. Mercury exposure from restoration depends on the size and number of restorations, its composition, patients chewing habits, texture of the food, brushing, grinding of teeth, and a lot of other physiological factors[5]. Amalgam's universal acceptance as a restorative material came after the investigations of Black in 1895, 1896, 1908[6]. Dental amalgam as defined by the American Dental Association (ADA) is an alloy that is composed of mercury, tin, copper, and silver along with some other metallic compounds added to enhance its physical and mechanical properties[7]. The purpose of this paper is to review the literature regarding the toxicology and adverse effects of mercury from dental amalgam, to evaluate and ensure safety on dental amalgam use.

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Mercury exposure from dental amalgam restorations

Can occur through several ways: (1) Elemental mercury released from dental amalgam which is present in the aerosol can be inhaled; (2) Particles of dental amalgam abrading from restored surfaces during mechanical wear of restorations or can even be produced

while placing or replacing the restorations, and the abrading particles from the surface restorations could be ingested; (3) Swallowing of the dissolved corrosion produced inorganic and elemental mercury products from saliva can take place; (4)"tattooing"[8].

Adverse effects of amalgam restorations: 1. Fluoride and mercury are widespread in the natural environment. 2. When high levels of exposure occur, adverse health effects have been observed. Fluoride and mercury are widespread in the natural environment. 3. When high levels of exposure occur, adverse health effects have been observed.

Fluoride and mercury are widely spread in our natural environment. Adverse health effects have been observed earlier whenever high-level exposure has occured[9]. There has been a reasonable understanding of the pharmacokinetics of mercury, its absorption, distribution, and elimination[10]. Several studies have reported that mercury levels in the urine and blood are indicative of amalgam exposure by the dental filling in the general population and by the occupational practice in dental practitioners[11][12][13]. Mercury vapor exposure is usually linked with occupational and accidental exposures[14][15].

Some of the local adverse effects include:

a) Corrosion -While amalgam has known to be a strong and durable restorative material, different phases in amalgam have different corrosion potential[16].

b) Amalgam tattoos- have been generally diagnosed clinically to beas dark grey to blue, flat macules rendering a sub-mucosal cluster of embedded amalgam that remains unchanged for several years. They have been found very commonly in the alveolar mucosa and the gingivae[17]and present in barely 1% of adults[18].

c) oral lichenoid reactions and erythematous lesions on the tongue and mucosa, are mainly due to abrasion of the restoration by the rough surfaces. Any restoration that is not appropriately placed, finished and polished can induce such an effect. These types of adverse mucosal reactions can usually resolve on taking out of the restorative material and will not require additional treatment[19].

Systemic Inflammation and Autoimmunity Related Outcomes

In the inclusion of allergic mechanisms, some studies on dental amalgam have examined the possible relevance to systemic inflammations and autoimmunity[20]. The primary effects on the human body include a change in the cell membrane, morphology of mitochondria, and physiologic differences in enzymatic activity. The central nervous system (CNS) is the most affected, which can display higher-significant deleterious results, involving tremors, abnormal reflexes, paraesthesia, nerve-conduction disturbances, headaches, balance disorders, changes in the pupillary reflex, language disorders, changes in the ability to spell, and disturbances of memory, concentration, and motor coordination[21][22]. Renal - Kidney Dysfunction multiple studies have inspected the outcome of the existence of amalgam restorations on the extent of mercury present in urine and bodily fluids[23]. Episodes of a true allergy to mercury have been rare and attempts to link its usage with conditions like multiple sclerosis and Alzheimer's disease has not been proven significantly, however, there may be some union between amalgam restorations and oral lichenoid lesions[24].

Risks to Dental Personnel

For long it has been recognized that in dentistry chronic exposure to mercury vapor owing to inadequate manipulating of dental amalgam can pose a potential health hazard in the workplace [25]. The use of dental amalgam has the potential for continuous occupational exposure of a dental practitioner to mercurial vapor that may be absorbed via the skin and the lungs [26][27]. Mercury poisoning could be characterized by tumours of arms, legs, or face and could also be incorporated with progressive, tremulous illegible handwriting, and slurred speech. It is been published by literature research that Dentists manipulating with amalgam have chances of increased mercury exposure [28][29][30]. One study has revealed that dental female assistants exposed to amalgam elicit a high rate of infertility [31]. Some Studies have witnessed that workers exposed to mercury also experience problems with eyesight, digestion, and urinary system [32][33][34]. The American Dental Association alarmed that amalgam filling material is hazardous to the dental office personnel but could be

safe in patients' mouths [35].

Handling mercury is the most critical and dangerous exposure channel. The exposure limit at workplaces is regulated by each country, as per its occupational exposure limit.

Mercury exposure risk can be minimized by ensuring careful handling procedures. Instantaneously steps should be taken for shielding the health of dentists and dental assistants through relevant preventive measures.

Testing for mercury toxicity: The average daily dose of inhaled mercury vapor was 1.7 μg (range from 0.4 to 4.4 μg), which is approximately 1% of the threshold limit value of 300 to 500 μg/day established by WHO, based on a maximum allowable environmental level of 50 μg/day in the workplace. Numerous diagnostic methods to detect the level of mercury in the body exist, which include tests for urine, saliva, stool, blood, hair analysis, and others. These tests determine if mercury is in the body and/or if it is being excreted. A study was conducted measuring intraoral vapor levels over a 24-h period in patients having at least nine amalgam restorations exhibited that the average dose of daily inhaled mercury vapor was about 1.7 μg (range from 0.4 to 4.4 μg), which approximates 1% of the threshold limit value of 300 to 500 μg/day indicated by WHO, based on a maximum permitted environmental level of 50 μg/day in the workplace[36]. Electrolyte assays, Complete blood cell count, renal, and hepatic function tests are some of the general laboratory tests available to detect mercury intoxication. Cardiovascular monitoring, Electrocardiography (ECG), electroneuromyography, pulmonary function test (PFT), and neuropsychological tests are also sometimes used for the evaluation[37].

The most precise way to calibrate the level of mercury in the body would be by detecting concentration levels of mercury in each organ tissue. However, as this can turn to be a strenuous task, using samples of hair, blood, urine, or fingernail remains the most common method of mercury measurement. As per some studies on occupational mercury exposure, recent exposure to mercury is supposedly reflected in blood and urine mercury concentration levels[38][39]. To date, there are no universal criteria available for the diagnosis of mercury overload.

The safe and effective use of dental amalgam: Effective management of amalgam includes placement, removal, storage, elimination, and disposal of amalgam waste as well as amalgam spills/mercury spills 'management during the phase-down period:

1. Amalgam Placement

a. Instrument or technology modification;

b. Modifying process during placement;

c. Operative changes e.g. Enhancement of house-keeping and inventory control;

d. Reforming or re-designing of amalgam product; and

e. Establishment of Standard guidelines for mercury spills management.

2. Removal of Amalgam Restorations: Standard guidelines must be established for use by dentists. These guidelines will include:

a. Using a rubber dam;

b. Using a special suction tube;

c. fasters cutting burs for reducing mercury vapor;

d. Using the copious amount of water during cutting;

e. Cutting, breaking amalgam into chunks;

f. Ensure using safety goggles;

g. Advocate clean filtered air in the dental surgery; and

h. To avoid any contact with mercury and amalgam particles or scraps cover skin completely.

3. Amalgam waste storage: Before dispose of appropriately storing amalgam waste in a sealed container containing water, as a part of the medical waste to avoid vaporization of any spills.

4. Amalgam waste disposal: Modern methods should be employed for disposing amalgam waste on contrary to the traditional methods of solid waste disposal[40].

Conclusion

Globally the consumption and production of mercury has been declining, although the advocacy in discontinuing and banning dental amalgam as a dental restorative material is been considered to be unwarranted and unsubstantiated, as its direct relation to systemic adverse effects has not been scientifically proven. As a principle of toxicology, we have to accept that there might be certain groups in the community who can be sensitive to mercury exposure and require minimization. By taking safe and effective measures it is viable to help reduce the environmental freight of mercury from the dental clinics. Amalgam restorations, therefore, endure to be safe and effective. Although dental amalgam use is trending towards minimization, still there continues to be a wide-spread belief that in certain clinical situations dental amalgam is a material of choice. Dentists need to educate their patients and even the health care professionals who might have been overly concerned regarding amalgam safety. However, amalgam due to its durability, reliability, and technique insensitivity runs to be one of the best bargains in the operative and restorative armamentarium.

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