

Mercury Release from Amalgam Restorations and Its Health Effects : A Review

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Abstract :

Aim: To review the release of mercury from the amalgam restorations and its effects on health.

Objective: The main objective of the review is to analyse the various causes for the release of mercury and the amount of mercury released from restorative procedures and its intensity of toxicity that causes various significant hazards to the health of an individual.

Background: Amalgam is one of the most popular dental restoratives, but concerns exist over its safety because of the mercury in its formulation. Mercury in dentistry has re-emerged as a contentious issue in public health, predominantly because so many people are inadvertently exposed to mercury in order to obtain the benefits of dental amalgam fillings, and the risks remain difficult to interpret.

Reason: This review questions whether adverse health effects are attributable to the amalgam derived mercury. Mercury though it is known to be substantible, it also leads to various health hazards. The review might give a knowledge about the risks of mercury and its prevention.

Keywords : amalgam restorations, health hazards, mercury, safety concerns.

INTRODUCTION :

According to the American Dental Association (ADA), dental amalgam is an alloy composed of mercury, silver, tin, and copper along with other metallic elements added to improve physical and mechanical properties [1] . It has an excellent clinical track record and has successfully been used in dentistry as a restorative material for more than 170 years [2]. It has several positive characteristics compared with other restorative materials used in dentistry including easy placement in the prepared tooth, relatively low cost, good wear resistance, low creep , low technique sensitivity, high compressive strength, relatively high longevity ,minimal dimensional change with time and high strength [3-7] . However, the release of mercury from dental amalgam has always been a matter of concern.

The purpose of this paper is to review the toxicity of mercury from dental amalgams and to evaluate its adverse health effects.

FORMS OF MERCURY

Dental amalgam has always generated some concerns due to the content of mercury (Hg) which is around 40-55% [8] . In order to better understand the issue of mercury in amalgam, various forms of mercury has been reviewed.

Mercury exists in three forms : inorganic, organic and elemental or metallic mercury. Inorganic mercury appears as a white powder or crystals and exists in the form of salts of mercury [9]. It can be highly toxic and cause renal failure and loss of the gastrointestinal tract lining [10] . Methyl mercury is the most common form of an organic mercury. It is water-soluble and damages the embryos [10] . Almost all human ingestion of Methyl mercury is from contaminated fish and wildlife. Finally, elemental or metallic mercury is a silver/white liquid at room temperature and is used in fluorescent bulbs, advertising signs, thermometers, barometers and, of course, dental

amalgam. Mercury in its liquid form readily passes through the intestinal tract with little absorption and has no known acute adverse physiologic effects [11-13] . It emits mercury vapour which enters the blood through alveolar membranes and crosses the blood/brain barrier into the central nervous system.

RELEASE OF MERCURY FROM DENTAL AMALGAM RESTORATIONS

Mercury vapour can be released from dental amalgam during all steps involved with the restorations like trituration, condensation, setting, polishing, and removal. Mastication and drinking hot beverages cause release of mercury from dental amalgam restorations as well [14] . Mercury either evaporates to mercury vapour or released from the material as metal ions. These ions may pass into the oral fluids to be ingested via the digestive system- 40% is due to this ingestion. Mercury vapour in the oral cavity may be exhaled or inhaled into the lungs and absorbed via the respiratory system – 60% is via the inhalation from mercury vapour [15] . Mercury from dental amalgam fillings represents an average 25-50% of total mercury absorbed per day [16] .

MERCURY ABSORPTION FROM DENTAL FILLINGS :

Mercury vapour dissolves in the intraoral air or saliva. It is absorbed rapidly in the respiratory tract and distributed by blood to a number of key target organs. The key target organs are the central nervous system, which appears to be the most sensitive toxicological endpoint observed following exposure to mercury vapour, and the kidneys [16].

Metal ions is absorbed in the gastrointestinal tract. Inorganic mercury has limited capacity to penetrate blood-brain or placental barriers, thus the most sensitive toxicological endpoint observed following exposure to inorganic mercury is kidney function [17].

Mercury exposure from dental amalgam restorations occurs through several ways: (1) aerosol air containing elemental mercury released from the dental amalgam can be inhaled; (2) dental amalgam particles can be abraded from restored surfaces during mechanical wear of the restorations or can be produced during placement or replacement of the restorations, and these abraded particles from the restorations can be ingested; (3) the saliva into which both elemental and corrosion-produced inorganic mercury products are dissolved can be swallowed; (4) "tattooing". Lorscheider and his coworkers (1995) pointed out that dental amalgam restorations were the major contributing source of mercury in humans who were not occupationally exposed to mercury and reported that research evidence had not supported the safety of dental amalgam at that time [18].

TOXICITY OF MERCURY

Although there is a release of mercury vapour from dental amalgam, the quantities are very small and do not cause verifiable adverse effects on human beings. The major toxic effects of methyl mercury are majorly on the central nervous system. Paresthesia, numbness or a "pins and needles" sensation is the first symptom to appear at the lowest dose. This may progress to cerebellar ataxia, dysarthria, constriction of the visual fields, and loss of hearing.

Studies on dentist have suggested adverse effects at air concentrations lower than 50 µg Hg /m³. Average air concentrations as low as 14 µg Hg/m³, were associated with decreased performance on psychomotor tests. Mood and behaviour changes have also been noticed, such as emotional liability, somatosensory irritation, and alterations in mood scores [19].

Dental amalgam restorations release not only elemental mercury, but also inorganic mercury, as corrosion products [20]. Accumulation of mercury has also been reported in organs like the lungs, liver, gastrointestinal tract, and exocrine glands [21]. Furthermore, long-term dermal exposure to inorganic mercury may also lead to toxicity. It has also been reported that level of mercury in the kidneys, thyroid, and brain were higher with higher numbers of amalgam surfaces [22].

The highest mercury concentration was found in the cerebral cortex and the pituitary gland [23]. Increased mercury levels in the liver, spleen, and lungs with increased numbers of amalgam restorations were also reported [24].

SIGNS AND SYMPTOMS OF HEALTH EFFECTS:

The association between dental amalgam fillings and a range of diseases or symptoms of unknown aetiology has been the starting point for concern over mercury absorption [25]. Certainly patients with dental amalgam reported the symptoms such as irritability, depression, numbness and tingling in the extremities, frequent night urination, chronic fatigue, cold hands and feet, bloating, memory loss anger and constipation [26].

Allergic reactions to mercury may occur. These allergic reactions usually disappear in a couple of days or after removal of these restorations [27].

HEALTH EFFECTS ON SPECIFIC ORGANS OF DENTAL AMALGAM

Renal - Kidney Dysfunction

Several studies have investigated the effect of the presence of amalgam restorations on the levels of mercury in urine and other bodily fluids. A study investigated urinary mercury levels in German children age 3-15 years with and without amalgam restorations. The mean urinary mercury concentration for the 93 children without amalgams was 0.17 µg/L, compared to 0.70 µg/L for the 86 children with amalgam restorations. A significant difference in urinary mercury levels was found between the two groups, as well as a positive correlation between the number of amalgam surfaces and urinary mercury levels [28].

Dunn and others randomly assigned 534 children age 6-10 years to either an amalgam or resin composite group and studied them over a five-year period during which they received amalgam or resin composite restorations. Among other things, the authors compared urinary mercury levels at various points with baseline values from the children when they had no amalgam restorations. They reported that the number of amalgam restorations had a significant dose response relationship with urinary mercury levels. Interestingly, they also found that daily gum chewing in the presence of amalgam was associated with these elevated levels [29]. Other studies have focused on the possibility that mercury exposure from amalgam restorations leads to impaired kidney function. It is concluded that no signs of renal toxicity could be found in conjunction with mercury released from amalgam fillings [30].

Neurological

The most well-known health hazard from mercury exposure is its adverse effect on neural tissue. Mercury's effects on neural tissue include demyelination, autonomic dysfunction, sensory nerve conduction delay, abnormal neuronal migration and abnormal central nervous system cell division [31].

One study has showed the effects of amalgam on mental health involving 587 subjects from an ongoing Swedish Adoption/Twin Study of Aging. This study employs controls for the genetic predisposition to the toxic effects of mercury when evaluating the role of amalgam restorations. The researchers analyze associations between the number of surfaces restored with dental amalgam and indices that estimate somatic health, mental health and memory functions. The most current results indicate no negative effects on physical or mental health due to the presence of dental amalgam [32].

It was concluded that amalgam fillings did not have significant differences in neurobehavioral assessments.

IMMUNE SYSTEM

The possibility that amalgam restorations have an adverse effect on T-lymphocytes and, therefore, compromise the immune system, has been the subject of study for more than 20 years. The theory that dental amalgam negatively affects the number of T-lymphocytes was suggested by a pilot study in the 1980s [33].

A later study specifically investigated the potential for amalgam to reduce immunocompetence by measuring levels of the three major groups and six subgroups of T lymphocytes in 37 subjects: 21 with amalgam restorations and 16 without. The authors found no evidence that amalgam restorations either affected lymphocytes or reduced immunocompetence [34].

CONCLUSION :

The use of dental amalgam in dentistry has been decreased markedly due to the mercury concerns. Mercury is released at very low levels from restorations which is absorbed in the lungs. Inorganic mercury is absorbed in the gastrointestinal tract. However, There is no evidence that this mercury is associated with signs or symptoms of adverse health effects or that removal of dental amalgam fillings is associated with better health outcomes.

According to the available data, it can be concluded that

- Mercury from dental amalgam fillings does not contribute to systemic toxicological effects.
- Allergic reactions to mercury from dental amalgam restorations may be present but are extremely rare.
- There is no justification that the discontinuation of dental amalgam use from clinical practice has better health outcomes.

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