

## Review Article



## Mercury Toxicity in Dentistry - A Review

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## ABSTRACT

This article is a review, based on the existing literature on mercury toxicity in dentistry. The objective of this review is to give a detailed description of various case studies and systematic reviews on mercury toxicity. Since elemental mercury is absorbed by dental professionals through direct skin contact or inhalation, the use of mercury in dental amalgam continues to be a controversial issue. This report reviews the literature, describes the use of mercury in odontology, and raises issues of concern for human health. This review recommends developing a program to minimize the use of mercury, lessen the potential for exposure, and control mercury waste. This will benefit dental workers by decreasing their exposure to this toxic material and will reduce environmental impacts from mercury in solid waste, in the air, and in waste water.

**Keywords:** Mercury, Dental amalgam, Toxicity, Fish, Urine Mercury, Neurodevelopmental disorder, restorations.

## INTRODUCTION

Mercury is one of the most toxic non-radioactive elements, and may cause toxicity even at low doses.<sup>1</sup> Dental amalgam has been used extensively as a restorative material in teeth for more than 150 years. Dental amalgam is an alloy of elemental mercury with other metals, which may include silver, tin, copper and zinc. Elemental mercury is a dense, metallic, silver-coloured liquid at room temperature. Mercury exposure from dental amalgam is chronic with low levels of Hg O released throughout the life of a restoration.<sup>2</sup> The American Dental Association (ADA) released a statement claiming "dental amalgam is considered a safe, affordable and durable material that has been used to restore the teeth of more than 100 million Americans."<sup>3</sup>

## Dental Amalgam in Pregnant women and Children

Mercury can cross the barriers like placental barriers, blood brain barriers, etc and hence, mercury from maternal amalgam fillings leads to a significant increase of mercury concentration in the tissues and the hair of foetuses and new born children. Number of amalgam fillings of the mothers was directly proportional to the level of mercury in the amniotic fluid, breast milk and infant body burden.<sup>4</sup> Autism severity and the mercury exposure from maternal amalgam fillings, in the prenatal development were found to have a relationship.<sup>5</sup> Dental amalgams, should not be administered to children less than eighteen years of age, pregnant women, or lactating women. Such product should not be administered to any consumer without a warning that the product contains mercury, which is a highly toxic element, and therefore poses health risks.<sup>6</sup>

Among children with amalgam fillings, younger ones and those of short stature and low weight were at significantly increased risk of high Urine Hg levels.

Mercury exposure and subsequent excretion is proportionally greater in younger children because they are smaller.<sup>7</sup> A sound basic guiding principle for usage of dental amalgam in young children, should be to keep mercury exposure as low as reasonably achievable while maintaining quality of care.

## Mercury Absorption

When mercury vapours are inhaled, 80% is readily absorbed in the blood through the lungs and distributed in various organs, mainly in the kidneys where it may become incorporated before being excreted.<sup>8</sup> Mercury can be retained in the brain<sup>9</sup> and foetal tissues<sup>10</sup> as they cannot re-cross the biological membranes like blood brain barrier and placental barriers, where they are oxidized from lipophilic metallic mercury into inorganic mercury which is not lipophilic in nature.

The amount of mercury from amalgam passing through the gastrointestinal tract may be large but is poorly absorbed.<sup>11</sup> Other routes of exposure, through electrochemical corrosion, and directly through the oral mucosa appear to be of considerably less important than inhaled vapor. During the past two decades, this material has come under increasing scrutiny with regard to its safety as it is known that amalgam restorations continuously discharge metallic mercury into the oral cavity, mostly in vapor form.<sup>12</sup> This release is enhanced during activities such as chewing, tooth brushing, drinking hot beverages, or oral breathing.<sup>13,14</sup>

## Mercury Level in Dentists

Mercury levels in whole blood were not high in exposed dentists, although it was reported that dentists have almost twice the concentration of mercury in their blood as non-dentists.<sup>15</sup> Dentists can eliminate use of mercury by using alternative filling materials wherever feasible. Today most dental amalgam is sold as encapsulated



preparation in which the powdered metals and elemental mercury are divided into separate compartments, and there is a physical divider which is broken just prior to use, by a device called as an amalgamator to achieve a pliable mass that is then placed in the prepared tooth, where it is sculpted and polished to achieve a contoured restoration.<sup>16</sup> Using personal protective equipment e.g., gloves, goggles, gowns to protect dental health care workers from direct exposure of liquid mercury or amalgam particles. Exposure to elemental mercury in the form of vapor has been regarded as a potential occupational hazard to dental professionals, as it is taken up by direct skin contact and through inhalation.<sup>17</sup> The National Institute for Occupational Safety and Administration (OSHA) has set the threshold limit value of exposure to mercury vapor at 0.05 mg per cubic meter of air for 8 hours a day, 40 hours a week.<sup>18</sup>

### Health complaints attributed to dental amalgams

The most commonly reported complaints attributed to dental amalgam are neurological symptoms such as fatigue and dizziness, mental symptoms such as concentration and memory disturbance, anxiety, irritability, restlessness and depression. Pain in muscle joints and pain in neck, shoulder, teeth, jaws, face and headache and gastrointestinal symptoms such as constipation, diarrhoea, bloating, mouth blisters, metallic taste, as well as increased susceptibility to infections, are also commonly reported.<sup>19,20</sup> Alterations in cell membrane and mitochondrial morphology and enzymatic activity are early events.<sup>21,22</sup> Such changes are often accompanied by increased urinary excretion of brush border enzymes, such as  $\gamma$ -glutamyl transpeptidase, alkaline phosphatase, and brush border antigens. With the progression of cellular injury, intracellular enzymes including lactate dehydrogenase, aspartate aminotransferase, and acid phosphatase escape into the bloodstream and urine.<sup>23</sup> Increased urinary N-acetyl- $\beta$ -D-glucosaminidase (NAG), a lysosomal enzyme, is an early index of kidney injury. Urinary NAG is sometimes the only renal parameter that is altered in workers exposed to HgO.<sup>24,25</sup> Many patients who had their amalgam fillings removed experience less severe symptoms after removal.<sup>26</sup>

### Non Dental mercury source

Primary source of Mercury exposure from diet is from fish consumption in the form of methylmercury.<sup>27</sup> Skin-lightening creams and other cosmetics manufactured outside the US may contain mercury compounds at levels exceeding the 1 $\mu$ g Hg/L limit set by the US, FDA.<sup>28</sup> Although any combination of exposures may contribute to total mercury body burden, the three species of mercury (i.e. elemental, inorganic ion and organic) each have unique absorption, distribution, metabolism and excretion pathways. Knowledge of these pathways is essential when evaluating the relevance of scientific studies.<sup>29</sup> Anthropogenic HgO emissions are produced by the combustion of fossil fuels, especially coal; the

extraction, treatment and recycling of mineral materials; and the incineration of mercury-containing waste.<sup>30</sup> Residential exposures to HgO may result from broken thermometers, blood pressure gauges or thermostats. Certain ethnic, religious and ritualistic practices also involve the use of elemental mercury.<sup>31</sup>

### CONCLUSION

We need to promote widespread awareness on the toxicity and health hazards caused by the usage of mercury, in order to get support at the highest levels of governments and NGOs to remove the barriers faced for the complete elimination of amalgam restorations. We need to commit to high-level mercury reduction and control within the medical communities and provide financial and technical assistance for investments in non-mercury products. We should create systems for safe collection and confinement of waste mercury. Since, some countries have successfully eliminated dental mercury amalgam, ending the use of mercury in dentistry has already proven to be both feasible and economical.

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