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Dental Mercury Amalgams

Mercury, identified thousands of years ago, is one of most potent toxins known. Strangely, it is still used in dental materials and placed permanently into the mouth.

Though the debate over its use in dental fillings has lasted over the last 150 years, mercury amalgam continues to be the most widely used filling material in dentistry. Fortunately, over 50% of American dentists no longer use mercury in their practice, and many will even remove dental amalgams and replace them with safer or biologically compatible material. Allegations of effects caused by mercury amalgams have involved many diseases. Those who oppose amalgam fillings argue that it is toxic, causes allergic reactions, can lead to oral galvanism, and is ecologically unsound. Considering the many available alternatives to traditional amalgams, we should question why this toxic dental material is still so widely used, and personally choose mercury-free dentistry. The two biggest sources of exposure to mercury for the general population are through our consumption of contaminated fish, and associated with medical and dental practices.

Ongoing scientific research gives us a more sophisticated understanding of the toxicity of mercury and its complex health effects. This is reflected by the fact that the “safe” levels are regularly reduced. First, it is also important to note that there are several different forms of mercury and that *all* forms are poisonous, some more than others. While all forms of mercury are toxic to humans, the pattern of toxicity varies with its chemical form, the route of exposure, the amount, the duration and timing of exposure,

and the vulnerability of the person exposed. Forms of mercury can be organized under three headings:

- **Elemental mercury** is also known as metallic mercury and is the type used in dentistry.
- **Inorganic mercury** compounds occur when mercury combines with elements such as chlorine, sulfur, or oxygen. These mercury compounds are also called mercury salts.
- **Organic mercury** forms when mercury combines with carbon. There is a potentially large number of organic mercury compounds; however, by far the most common organic mercury pollutant in the environment is the very toxic methylmercury, found in certain ocean fish. Thiomersal is also a type of organic mercury used as a preservative for certain vaccines and intravenous drugs.

Mercury easily forms alloys, called amalgams, with other metals such as gold, silver, copper, tin, etc. The ease with which it amalgamates with gold made it useful in recovering gold from its ores. Elemental mercury, as used in dental amalgams, is a shiny, silver-white metal that is a liquid at room temperature. Elemental mercury is also used in thermometers, some electrical switches and certain types of light bulbs. However, for safety reasons, consumer use of mercury in thermometers has become less common over the years, as digital thermometers have been introduced. At room temperature, some of the elemental or metallic mercury will evaporate and form mercury vapors. Mercury vapors are colorless and odorless. The higher the temperature, the more vapors will be released from liquid metallic mercury. Elemental mercury may be converted to soluble forms, which may become methylated in water, especially by microorganisms, which enter the food-chain and accumulate in ocean fish. The larger the fish, the more potential bioaccumulation in the fish. The EPA advises women to avoid eating ocean fish during pregnancy for that reason.

Dental amalgam fillings are approximately 50% elemental mercury; the remaining 50% is a mixture of other metals such as silver, tin, copper, nickel and zinc. The average

amalgam filling contains approximately 0.5 grams of elemental mercury.[1, 2] As much as 50% of mercury in dental fillings has been found to have vaporized after 5 years, and 80% by 20 years.[3, 4] Evidence that mercury enters the body through the vapors released from amalgam fillings is no longer disputed by the American Dental Association (ADA). Vapors are released when someone with an amalgam filling chews, grinds their teeth, eats hot food, or drinks hot drinks. Even acidic saliva can cause the amalgams to release vapor.[5] Vapor serves as the primary route of mercury delivery from amalgams into the body. A single amalgam filling with a surface area of only one-half square centimeter is estimated to release as much as 15 micrograms of mercury per day, primarily through evaporation and mechanical wear.[6, 7]

Dental Mercury Exposure and Body Burden

The main exposure paths for elemental mercury vapors from amalgam fillings are absorption by the lungs from intraoral air; vapor absorbed by saliva or swallowed; amalgam particles swallowed; and membrane, olfactory, sublingual venal, and neural path transfer of mercury absorbed by oral mucosa, and gums. Technically, mercury vapor can be transported to any tissue or organ in the body. On entry to the body, mercury vapor has great affinity for sulfhydryl groups and bonds to sulfur-containing amino acids throughout the body. Mercury vapor released from amalgams is fat soluble, and can pass through cell membranes and cross the blood-brain barrier.[8] Mercury vapor easily penetrates into the central nervous system where it inhibits thiol-sensitive enzymes. Intestinal absorption of mercury varies greatly among its various forms, with elemental mercury (as found in amalgam) the least-absorbed form. Absorption also varies according to individual factors such as gum chewing and bruxism, or tooth grinding. It has been reported in a WHO review of mercury that about 80% of inhaled elemental mercury is retained by the body, whereas liquid metallic mercury is poorly absorbed via the gastrointestinal tract.[9] The component mix in amalgams is an important factor in mercury vapor emissions. Studies have consistently found that modern high-copper, non-gamma-two amalgams release greater amounts of mercury vapor than conventional silver amalgams.[10, 11]

Elemental mercury is often transported to the brain[12], either dissolved in serum or adherent to red cell membranes. Elemental mercury passes easily through the blood brain barrier[13] and through the placenta, where it can deposit in the fetal brain[14]. Elemental mercury is, however, rapidly oxidized to mercuric mercury on entry to the blood stream[15], although not so quickly as to prevent considerable uptake by the central nervous system while still in the metallic form. According to the NIH study about 90% of the mercury in our bodies is elemental mercury, not methyl-mercury, showing the exposure is more likely from dental amalgams than from fish.[16] This is why dental amalgams have been found to be the major contributor to human body mercury burden.

Current Politics of Dental Mercury

The FDA has been short-coming in its safety review of dental amalgam. In 2006, the FDA consulted a Joint Panel of physicians and dentists to review the FDA's own White Paper[17] on dental amalgam. The Panel ruled 13 to 7 that the White Paper did not demonstrate adequate proof of safety. In 2009, the FDA's position statement to the Scientific Advisory Board of the International Academy of Oral Medicine & Toxicology (IAOMT) stated[18], "it is incompatible with current, valid scientific evidence to continue to endorse or otherwise condone the use of a permanently implanted material in teeth that continuously emits a very potent enzyme inhibitor and metabolic toxin." However, in the same breath in August 2009, the FDA continued to classify dental amalgam "devices" in Class II, placing it in the same category as composite resins and gold fillings. As a result, the FDA prescribed no controls or other measures intended to protect the public against the potential dangers of dental amalgams.

Additionally, support at the NIH has been very sparse for investigating the relationship of elemental mercury exposure to neurological diseases or cancer. Hence, many believe that the FDA's continued refusal to banish mercury amalgam devices is not based on science, but rather political issues. If the FDA were to state that mercury amalgams cause harm, then the U.S. government would be responsible for hundreds of thousands of military personnel that had mercury amalgams placed in their mouth

during their military active duty. That could indeed be costly to the military industrial complex.

Additionally, the American Dental Association has long maintained that mercury-filled teeth are safe. In 1998, the ADA's Council on Scientific Affairs published its first major review of the scientific literature on dental amalgam which concluded that "based on available scientific information, amalgam continues to be a safe and effective restorative material."[19] The Council's report also stated that "There currently appears to be no justification for discontinuing the use of dental amalgam." A follow-up 2003 paper published in the New England Journal of Medicine stated, "Patients who have questions about the potential relation between mercury and degenerative diseases can be assured that the available evidence shows no connection."[20]

Interestingly, that same year a monograph on mercury toxicity from the World Health Organization concluded:

> "Studies on humans and animals have demonstrated that dental amalgam contributes significantly to mercury body burden in humans with amalgam fillings. Dental amalgam is the most common form of exposure to elemental mercury in the general population, constituting a potentially significant source of exposure to elemental mercury, with estimates of daily intake from amalgam restorations ranging from 1 to 27 µg mercury per day, the majority of dental amalgam holders being exposed to less than 5 µg mercury per day."[21]

Although the U.S. has not taken a stance against mercury amalgam fillings, many European governments have. For example, the governments of Norway, Sweden, and Denmark have banned the use of mercury amalgam fillings in dentistry. France has recommended that alternative mercury-free dental materials be used for pregnant women, and Finland, Austria, and Canada have worked to reduce the use of dental amalgam fillings for pregnant women, children, and patients with kidney problems. The

German Department of Health banned mercury amalgam use in women and children following the International Academy of Oral Medicine and Toxicology Conference in Düsseldorf in 1992. In 2012, a letter to European Union member state representatives and dental experts and the European Environmental Bureau also asked recipients to support a phase-out of the use of mercury in dentistry, both in the EU and around the world.

As for the U.S. and Canada, now that the entire EU is taking a strong stand to protect the health of children and pregnant/nursing women, the U.S. Food and Drug Administration (FDA) and Health Canada will be pushed to reconsider their stance. So far, however, they have both chosen to protect amalgam producers and the profits of pro-mercury dentists.

The underlying irony is that in any other situation besides in dental amalgams, mercury is *understood* to be poisonous. For example, if a mercury thermometer broke in a school, students and teachers would immediately evacuate. We would probably hear about such an event on the evening news. Any science teacher encouraging students to put mercury in their mouths would be fired for gross negligence and likely prosecuted for endangering the health of a child. Yet dentists do it every day.

The issue of mercury amalgam and its connection with chronic diseases and cancer is still highly debated. However, the EPA has classified inorganic and methylmercury as “possible human carcinogens.” In addition, the International Agency for Research on Cancer has also classified methylmercury compounds as a “possible human carcinogen.”

Removal of dental mercury amalgam has been shown to lead to improvement of various chronic complaints in a significant number of patients in various trials. It is important to be aware, however, that many dentists no longer use mercury amalgams primarily because they believe other products are more effective, not because they believe that dental amalgams are toxic. Because of this, they may not take proper precautions when

treating teeth that have already been repaired with dental amalgams, nor take proper precautions when replacing dental amalgams with safer materials. If amalgam fillings are removed without proper safety precautions, a patient may be exposed to much more mercury, and be at greater risk of mercury poisoning than if they did nothing. In essence, removing amalgam fillings improperly can be dangerous. For this reason, it is important to find a biological dentist who is not only mercury free, but also mercury safe.

Dental Mercury Toxicology Research

Several toxicologists since the 1950's have published that mercury is an unsuitable element to use in dentistry and is not safe.[22, 23, 24, 25] Three medical researchers, Dr. Fritz Lorscheider, Dr. Murry Vimy, and Dr. Anne Summers, were asked by the Federation of American Societies for Experimental Biology Journal to review scientific findings on amalgam. They state, "Research evidence does not support the notion of amalgam safety," and concluded:

> "The experimental evidence indicates that amalgam mercury has the potential to induce cell or organ pathophysiology. At the very least, the traditional dental paradigm, that amalgam is a chemically stable tooth restorative material and that the release of mercury from the material is insignificant, is without foundation."[26]

Drs. Lorscheider and Vimy have shown definitively that mercury is continuously released from amalgam fillings, both as vapor and in microscopic particles, once the fillings are placed in the teeth. The mercury emitted from the fillings is transported to every part of the body via the air pathways, the digestive tract and the blood stream, and accumulates in tissues and organ systems.

Most studies rely on assessing mercury exposure at the time of study, which may not be fully informative, because mercury has a long half-life in the body. Thus, mercury accumulates through continuous exposure, making it difficult to evaluate health effects at different levels of exposure. Evidence is clear that dental mercury transfers to human tissues, accumulates over time, and presents a potential threat to health.[27, 28]

Autopsy studies are the most valuable and informative studies for examining the amalgam-caused mercury body burden. In a 2006 autopsy study published in the *American Journal of Forensic Medical Pathology*, it was found that individuals with more than 12 amalgam fillings have more than 10-times higher mercury levels in several tissues including the brain, compared to individuals with only 0-3 amalgam fillings. The same study showed that the average mercury level in the brain of EU citizens with more than 12 amalgam fillings was 300 ng Hg/g brain tissue, which is well above mercury levels proven to be toxic in vitro on neurons (0.02 -36 ng Hg/g).[29]

People with several amalgam fillings have *grams* of mercury in their mouths. The greater number of amalgam fillings present, the larger the quantity of mercury in blood and urine. Hence, the level of blood and urine mercury positively correlates with the number of amalgam fillings. This was confirmed by a study of military personnel funded by the NIH.[30] In that study, the amount of mercury in the urine increased about 4.5-fold in soldiers with the average number of amalgams versus the controls with no amalgams. In extreme cases, mercury levels were over 8-fold higher.

Pathophysiology of Dental Mercury

The mercury vapor from dental amalgams is toxic and detrimental to the body's physiology, organs, glands and tissues. Some individuals claim that elemental mercury found in mercury amalgams is not as toxic as methylmercury present in various seafood. However, it must be understood that mercury in any form is poisonous. Some people are hypersensitive to mercury, which appears to be a matter of individual tolerance and genetic detoxification variables. Basically, mercury is toxic to all cells in any amount and damage may precede clinical effects. Elemental mercury from dental fillings accumulates in the body and has the potential to damage the nervous system, brain, heart, lungs, liver, kidney, blood cells, and endocrine glands. Mercury is a deadly neurotoxin[31, 32, 33] and damages the nervous system through several potential mechanisms. Mercury binds to sulfhydryl groups and incapacitates key enzymes

involved in the cellular stress response, protein repair, and oxidative damage prevention.

There is some evidence that elemental mercury from dental amalgams can transform to methylmercury in the body.[33] This can potentially occur under the action of certain oral or intestinal bacteria.[34] Unfortunately, there has only been a few *in-vitro* studies investigating this chemical transformation. It logically makes sense, however, that certain human bacteria could methylate mercury, because it is bacteria in the environment that methylates mercury which results in contaminated fish. Hence, elemental mercury can transform to the more dangerous methylmercury in the body.

Again, all forms of mercury are toxic, but methylmercury has been shown to be very damaging to the body. Methylmercury disrupts the muscarinic cholinergic systems in the brainstem and occipital cortices as well. Methylmercury also inactivates sodium-potassium adenosine triphosphatase (Na+/K+-ATPase), which leads to membrane depolarization, calcium entry, and eventual cell death. Necrosis of the proximal tubules is a common direct renal toxic effect. All forms of mercury are toxic to a fetus, but methylmercury most readily passes through the placenta. Even with an asymptomatic patient, maternal exposure can lead to spontaneous abortion or retardation.

With slow bioaccumulation of mercury from dental amalgams, symptoms can individually vary. It is said that mercury is the “great masquerader,” as the symptoms of mercury intoxication are diverse. Patients can present with a myriad of complaints such as numbness, tingling, hearing loss, rashes, visual difficulties, gait unsteadiness, and tremulousness, as well as emotional and cognitive difficulties.

Studies have consistently shown that mercury can suppress the body’s immune system in several ways.[34, 35, 36, 37, 38, 39, 40, 41, 42, 43] Specifically, mercury has been shown to damage and inhibit immune T-cells, B-cells, and neutrophil function.[44, 45, 46, 47, 48, 49] Any toxin that suppresses immune function increases the risk of developing cancer, or can predispose a patient to a cancer recurrence.

In 1990, researchers conducted a primate study to trace possible accumulations of mercury in organs and tissues from implanted mercury amalgams. The study revealed that amalgam fillings (total, 0.7-1.2 g) caused deposition of mercury in the following tissues: spinal ganglia, anterior pituitary, adrenal, medulla, liver, kidneys, lungs, and intestinal lymph glands. The researchers concluded that:

> "These results strongly support what has been suggested previously that dental fillings in primates cause absorption of mercury released from amalgam fillings through lungs and intestinal tract, and that depending on exposure mercury is distributed to most organs and will eventually be found in the central nervous system."[50]

These above studies demonstrate that mercury from amalgam fillings accumulate in tissues of the body and has the potential to methylate to methylmercury which is highly toxic. Mercury is toxic to all tissues and greatly damages the cellular immunity. For those with breast cancer who need a strong immunity, mercury is a poison that needs to be eliminated.

A German study found that during the first week after birth, the amount of mercury in mothers' milk was positively correlated with the number of mercury amalgam fillings that the mother had. They further concluded that at two months after birth, the amount of mercury in breast milk was much lower and associated with the mothers' fish consumption, rather than the number of amalgam fillings. These authors concluded that "The additional exposure to mercury of breast-fed babies from maternal amalgam fillings is of minor importance compared to maternal fish consumption."[51]

Numerous scientific reports have shown a relationship between certain chronic, or unexplained illnesses, and the presence of mercury in the body.[52, 53, 54, 55] Some researchers have published studies on mercury's role in the development of Alzheimer's[56, 57], multiple sclerosis[58], and other neurological diseases like Parkinson's[59].

A human autopsy study comparing the brain tissue of people with Alzheimer's disease with an age-matched group of brains from people without Alzheimer's disease showed the Alzheimer's group experienced a significantly higher concentration of mercury in all the areas of the brains involved in memory function.[60] Research has demonstrated that exposure of neurons in culture to sub-lethal doses of mercury causes the formation of neurofibillary tangles, the increased secretion of amyloid protein and the hyper-phosphorylation of a protein called Tau.[61] All three of these mercury-induced conditions are regularly identified as the major diagnostic markers for Alzheimer's disease. In the manuscript published in the *Journal of Neurochemistry* the authors state "These results indicate that mercury may play a role in the pathophysiological mechanisms of Alzheimer's disease."[62]

In breast cancer patients, both detoxification function and immunological mechanisms are impaired to some degree. Our ability to protect ourselves from the toxic damage caused by exposure to mercury of all sources depends on the level of protective natural biochemical compounds (e.g. glutathione, metallothionine) in our cells. The levels of these protecting agents depend upon our health condition. If we become ill, as with breast cancer, the cellular levels of glutathione drop and our protection against the toxic effects of mercury decreases. Mercury toxicity from amalgams is one issue, but the galvanicity from the metals in the mouth is also a concern.

Oral Galvanicity

People with dissimilar metals in their mouth, such as gold fillings together with mercury/ silver amalgams, experience what is termed *oral galvanicity* by electrical currents passing between these conductive metals. Oral galvanicity causes more mercury vapor to release from the amalgam than would normally occur.[63, 64] Actually, there are two types of electrical activity on the surface of a mercury amalgam or gold filling. One is just like a regular battery, called *bimetallic*. Bimetallic activity happens when two or more dissimilar metals are in an electrolyte solution that conducts electricity. This bimetallic activity will produce a current or a flow of electrons. The other type of electrical activity is called *differential aeration*, which occurs between saliva and areas of the gingiva that

contain different amounts of oxygen. Such currents are normally coupled to corrosion of metals and release of metal ions. When mercury fillings are close to gold crowns, the mercury released into the body can be as much as ten times greater when compared to mercury fillings alone.[65] Oral galvanism also increases the rate of corrosion (or dissolution) of metal-based dental restorations and replacements. Hence, a visible warning sign of galvanism is corrosion of the metal in the mouth.[66] Additionally, mercury and silver from fillings can be seen in the tissues as amalgam “tattoos”, which have been found to accumulate in the oral mucosa.

Not only does oral galvanicity cause more mercury vapors to be released and dental corrosion, but the amperage of the current is strong enough to influence brain impulses. The brain operates on 7 to 9 nano-amps which is 1000 times weaker than the currents resulting from metal fillings found in the oral cavity. As far as the brain is concerned, that is the difference between touching a 9-volt battery and sticking your finger in the light socket. Since the upper teeth are less than 2 inches from the brain, adding this much excess electrical activity can create misdirected impulses in the brain.

In summary, mercury amalgam fillings consist of 50% elemental mercury. Elemental mercury, like all types of mercury, is toxic. Mercury vapor is continuously released from amalgam fillings and contributes substantially to human mercury load. Elemental mercury accumulates in organs, glands and tissues, particularly in the brain and central nervous system. Review of recent literature suggests that mercury from dental amalgams may lead to nephrotoxicity, neurobehavioral changes, immune depletion or autoimmunity, and cause numerous symptoms and complaints. The development of several neurodegenerative diseases has also been linked to mercury amalgam accumulation. There may be individual genetically or acquired susceptibilities for negative effects from dental amalgam. The bottom line is that evidence clearly demonstrates that mercury amalgams vaporize, are absorbed and emit significant levels of neurotoxic, immunological mercury that are injurious to human health, and could exacerbate the medical condition of those individuals with kidney disease, immunological and neurological diseases, as well as cancer.

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