



# THE ROLE OF MERCURY IN PERIODONTAL DISEASE AND ORAL HEALTH PROBLEMS

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## **I. Introduction & Mercury Exposure Levels from Amalgam**

Mercury is one of the most toxic substances in existence and is known to bioaccumulate in the body of people and animals that have chronic exposure. Mercury exposure is cumulative and comes primarily from 3 main sources: occupational exposure, food (mainly fish), and silver/mercury dental fillings. Whereas mercury exposure from fish is primarily methyl mercury, mercury from occupational exposure and dental fillings is primarily from elemental mercury vapour. But bacteria in the mouth and intestines methylate other forms of mercury to methyl, and some demethylation also occurs.

The most common type of occupational exposure comes from dental office exposure and is documented to result in significant adverse health effects (602). Mercury in amalgam fillings, because of its high volatility and galvanic action due to presence of dissimilar metals in the mouth, has been found to be continuously vapourised and released into the body (192, 600, etc.), and has been found to be the largest source of mercury in the majority of people who have amalgam fillings (WHO: 18, 183, 199, 209, 601). The level of daily exposure commonly exceeds the U.S. EPA health guideline for daily mercury exposure (2, 217, 601).

Concentrations of mercury in oral mucosa for a population of patients with 6 or more amalgam fillings taken during oral surgery were 20 times the level of controls (174). Studies have shown mercury travels from amalgam into dentin, root tips, and the gums, with levels in roots tips as high as 41 ppm (192). Studies have shown that mercury in the gums such as from root caps for root canal teeth or amalgam tattoos result in chronic inflammation, including proliferation of inflammatory cytokines in addition to migration to other parts of the body (35, 47, 86a, 200, 314a).

Mercury and silver from fillings can be seen in the tissues as amalgam “tattoos”, which have been found to accumulate in the oral mucosa as granules along collagen bundles, blood vessels, nerve sheaths, elastic fibres, membranes, striated muscle fibres, and acini of minor salivary glands. Dark granules are also present intracellularly within macrophages, multinucleated giant cells, endothelial cells, and fibroblasts, and metals also accumulate in tooth roots and the jaw bone (35, 47).

There is in most cases chronic inflammatory response or macrophagic reaction to the metals (47), usually in the form of a foreign body granuloma with multinucleated giant cells of the foreign body and Langhan’s types (192). In a group of patients with amalgam tattoos that were tested, 74% of the patients revealed high lymphocyte reactivity (positive MELISA test) to one or more metal components of dental

restorations (47k). The majority of MELISA positive patients suffered from serious health problems (various allergies, autoimmune diseases, Parkinson's syndrome etc.). Nickel and inorganic mercury were the most common sensitizers in vitro. The cytokine assay revealed that mercury chloride activated predominantly TH2 lymphocytes, while nickel chloride activated mainly TH1 lymphocytes.

Most dentists are not aware of the main source of amalgam tattoos, oral galvanism where electric currents caused by mixed metals in the mouth take the metals into the gums and oral mucosa, accumulating at the base of teeth with large fillings or metal crowns over amalgam base (192). Such mercury including that in the commonly formed amalgam tattoos moves to other parts of the body over time in significant amounts and more rapidly than the other metals.

Macrophages remove mercury by phagocytosis and the mercury moves to other parts of the body through the blood and along nerves (47). Another study (47l) demonstrated a dense mononuclear inflammatory infiltrate associated with large and powdered debris and positivity for HLA-DR and MT in inflammatory cells. While blood vessel walls and connective fibre impregnated with powdered particles were negative for HLA-DR, they were positive for MT.

In addition, wherever epithelial basement membrane impregnation by powdered amalgam particles was observed, a strong positivity for MT was detected. These findings demonstrate that residual elements of AT still have noxious local effects over tissues. Such metals are documented to cause local and systemic lesions and health effects, which usually recover after removal of the amalgam tattoo by surgery (47f, 47g, 47h, 47i, 47m). The high levels of accumulated mercury also are dispersed to other parts of the body.

Mercury vapour given off by amalgam fillings accumulates in the teeth, tooth roots, gums, jawbone, and oral tissue. The number of amalgam surfaces has a statistically significant correlation to the level of mercury in oral mucosa and saliva (18, 77, 79, 182, 199, 211, 222, 292).

The amount of mercury in saliva averaged between 1.5 to 1.9 micrograms per litre for each amalgam filling (199ab).

The amount of mercury released by a gold alloy bridge over amalgam over a 10 year period was measured to be approx. 101 milligrams (mg) (60% of total) or 30 micrograms ( $\mu\text{g}$ ) per day (18), and other studies have found similar results (182). The average mercury levels in gum tissue near amalgam fillings are often over 100 ppm

(192), and levels in oral mucosa removed during oral surgery averaged over 2 ppm (over 20 times controls ) and levels in root tips of 41 ppm (47, 174, 192).

Having dissimilar metals in the teeth (e.g. gold and mercury) causes galvanic action, electrical currents, and much higher mercury vapour levels and mercury levels in tissues (8, 18, 19, 27, 30, 47, 48, 174, 182, 191, 192). The level of mercury in the gums or jaw bone is often 1,000 ppm near a gold cap on an amalgam filling (25, 30, 35, 48, 58), and similar levels as high as 5,600 ppm have been found in the jaw bone under large amalgam fillings or gold crowns over amalgam by German oral surgeons (436).

These levels are among the highest levels ever measured in tissues of living organisms, exceeding the highest levels found in chronically exposed chloralkali workers, those who died from mercury in Minamata, or animals that died from mercury poisoning. The FDA action level for warnings of dangerous levels in fish or food is 1 ppm and the EPA health criterion level is 0.3 ppm. In patients with galvanic cell in their oral cavity we found decreased levels of anti-inflammatory markers, such as secretory IgA, IgA1, IgA2, and lysozyme, and increased levels of the pro-inflammatory marker albumin (192i).

Amalgam also releases significant amounts of silver, tin, and copper which also have toxic effects, with organic tin compounds formed in the body being even more neurotoxic than inorganic mercury.

German studies of mercury loss from vapour in unstimulated saliva found the saliva of those with amalgams had at least 5 times as much mercury as for controls (179,199]. Much mercury in saliva and the brain is also organic, since mouth bacteria convert inorganic mercury to methyl mercury (81, 88, 600). Oral bacteria streptococcus mitior, S. mutans, and S. sanguis were all found to methylate mercury (81, 600), as well as Candida albicans. Methyl mercury, like mercury vapour, crosses the blood-brain barrier, and both forms are converted to very neurotoxic inorganic compounds which have a long half-life in the brain. The process also results in formation of hydrogen sulphide and metal protein compounds that are involved in mouth odour (334).

A large U.S. Centers for Disease Control epidemiological study, NHANES III, found that those with more amalgam fillings (more mercury exposure) have significantly higher levels of chronic health conditions (543a). A 2009 study found that inorganic mercury levels in people have been increasing rapidly in recent years (543b). It used data from the U.S. Centers for Disease Control and Prevention's National Health

Nutrition Examination Survey (NHANES) finding that while inorganic mercury was detected in the blood of 2 percent of women aged 18 to 49 in the 1999-2000 NHANES survey, that level rose to 30 percent of women by 2005-2006. Surveys in all states using hair tests have found dangerous levels of mercury in an average of 22 % of the population, with over 30% in some states like Florida and New York (543c).

## **II. Oral Health Effects of Mercury from Amalgam**

A large study of 20,000 subjects at a German university found a significant relation between the number of amalgam fillings with periodontal problems (199). Some of the oral effects documented in the literature to be caused by amalgam include gingivitis, oral gum tissue inflammation, bleeding gums, bone loss, mouth sores, oral lesions, pain and discomfort, burning mouth (89), metallic taste, chronic sore throat, chronic inflammatory response, lichen planus autoimmune response, oral keratosis, oral cancer (251, 252), bad breath, mouth dryness, tender teeth, trigeminal neuralgia, sinusitis, TMJ, orofacial granulomatosis, oral lichen planus (86, 87, 88, 89, 90, 95), leukoplakia and amalgam tattoos (5, 27, 29, 48a, 86, 87, 88, 89, 90, 95, 192a, 303, 341, 525a, 582).

Amalgams are also a factor in periodontal disease (303, etc.). Removal of amalgam fillings led to cure or significant improvement for most of such oral health problems (8, 27, 56, 57, 75, 82, 86, 87, 90, 94, 95, 101, 115, 133, 145, 167, 168, 192a, 192b, 192c, 192f, 212, 222, 233, 303, 313, 317, 320, 321, 341, 525a, 582, etc.) and oral keratosis (pre-cancer) (87, 251, 252). For example, in one clinic (95) that replaced amalgams for a large number of such patients, there was cure or significant improvement in over 90% of cases for metallic taste, tender teeth, mouth sores, and bad breath and in over 80% of cases for bleeding gums and throat irritation. A Jerome meter was used to measure mercury vapour level in the mouth, and many had over 50 micrograms mercury per cubic metre of air, far above the Government health guideline for mercury (217).

Mercury accumulates in the trigeminal ganglia (303, 325, 329a, 329b) and can cause trigeminal neuralgia from which most recover after amalgam replacement (35d, 192a, 222, 303, 437b, 525a). Temporomandibular joint disorder (TMJ) is a common type of joint pain which can be caused by accumulation of mercury in the joint due to the high amount of mercury in the mouth area of those with amalgam fillings and due to inflammation, similar to arthritic effects on other joints caused by mercury(303). Accumulation of mercury in the cranial nerves is a common cause of tinnitus, TMJ, cataracts, loss of smell, etc. (303).

Cavitations from improperly healed tooth extractions also commonly cause trigeminal neuralgia and most such recover after cavitation surgery (35a, 437b). The periodontal ligament of extracted teeth is often not fully removed and results in incomplete jawbone re-growth resulting in a pocket (cavitation) where mouth bacteria in anaerobic conditions along with similar conditions in the dead tooth produce extreme toxins similar to botulism which like mercury are extremely toxic and disruptive to necessary body enzymatic processes at the cellular level, comparable to the similar enzymatic disruptions caused by mercury and previously discussed (35, 437a, 437b).

Extremely toxic anaerobic bacteria from root canals or cavitations formed at incompletely healed tooth extraction sites have also been found to be common factors in Fibromyalgia and other chronic neurological conditions such as Parkinson's and ALS, with condensing osteitis which must be removed with a surgical burr along with 1 mm of bone around it (35, 200, 437a, 437b). Cavitations have been found in 80% of sites from wisdom tooth extractions tested and 50% of molar extraction sites tested (35, 200, 437a, 437b). The incidence is likely somewhat less in the general population.

The interruption of the ATP energy chemistry results in high levels of porphyrins in the urine (260). Mercury, lead, and other toxics have different patterns of high levels for the 5 types of porphyrins, with pattern indicating likely source and the level extent of damage. The average for those with amalgams is over 3 times that of those without, and is over 20 times normal for some severely poisoned people (232, 260). The FDA has approved a test measuring porphyrins as a test for mercury poisoning. However some other dental problems such as nickel crowns, cavitations, and root canals also can cause high porphyrins.

Cavitations are diseased areas in bone under teeth or extracted teeth usually caused by lack of adequate blood supply to the area. Tests by special equipment (Cavitat) found cavitations in over 80% of areas under root canals or extracted wisdom teeth that have been tested, and toxins such as anaerobic bacteria and other toxics which significantly inhibit body enzymatic processes in virtually all cavitations (200, 437a, 437b). These toxins have been found to have serious systemic health effects in many cases, and significant health problems to be related such as arthritis, MCS, and CFS. These have been found to be factors along with amalgam in serious chronic conditions such as MS, ALS, Alzheimer's, MCS and CFS (35, 200, 204, 222, 292, 437). The problem occurs in extractions that are not cleaned out properly after extraction.

Supplements such as glucosamine sulphate and avoidance of orange juice and caffeine have been found to be beneficial in treating arthritic conditions as well (35).

Nickel and beryllium are 2 other metals commonly used in dentistry that are very carcinogenic, toxic, and cause DNA malformations (35, 456). Nickel ceramic crowns, root canals and cavitations have also been found to be a factor in some breast cancer and other cancers and some have recovered after TDR, which includes amalgam replacement, replacement of metal crowns over amalgam, nickel crowns, extraction of root canal teeth, and treatment of cavitations where necessary (35, 200, 228a, 486, 530). Similarly nickel crowns and gold crowns over amalgam have been found to be a factor in lupus (35, 229, 456) and Bell's Palsy from which some have recovered after TDR and Feldenkrais exercises (35). An analysis of the large U.S. NHANESIII population found that the age-adjusted geometric mean urine Cadmium concentration was significantly higher among participants with periodontal disease (240.) Smoking is known to be a common source of elevated cadmium level.

Toxic/allergic reactions to toxic metals such as mercury/amalgam often result in autoimmune conditions such as lichen planus lesions in oral mucosa or gums, eczema, pustulosis, dermatitis and play a role in pathogenesis of periodontal disease (85, 86, 87, 88, 90, 303, 313, 314, etc.). A high percentage of patients with oral mucosal problems along with other autoimmune problems such as chronic fatigue (CFS) have significant immune reactions to mercury, palladium, gold, and nickel (118, 313, 369). 94% of such patients had significant immune reactions to inorganic mercury (MELISA test) and 72% had immune reactions to low concentrations of  $\text{HgCl}_2$  (<0.5 ug/ml).

61% also had immune reaction to phenylHg, which has been commonly used in root canals and cosmetics (313). Removal of amalgam fillings usually results in cure of such lesions (75, 82, 86, 87, 90, 94, 101, 118, 133, 145, 167, 168, 313). Patients with other systemic neurological or immune symptoms such as arthritis, myalgia, eczema, CFS, MS and diabetes also often recover after amalgam replacement (86, 118, 313, 369, 600, etc.). 10% of controls had significant immune reactions to HgCl and 8.3% to palladium.

In a recent study of patients with oral lichen planus, 60% showed sensitisation to 1 or more allergens using a patch test (85). The greatest frequency of positive reactions was to dental metals. The order of tested metals according to frequency of positive reactions was mercury, amalgam, nickel, palladium, cobalt, gold, chrome, and indium. However, patch tests have been found to not be a reliable indicator of mercury immune reactivity or allergy (303, etc). In large number of clinical trials by

doctors treating oral lichen planus, between 39 and 53% of patients tested by patch tests were indicated to be reactive to mercury. However when patients had amalgams replaced, the majority recovered or significantly improved in a relatively short time period irrespective of patch test results. Thus the authors recommend replacement of amalgam in all cases of oral lichen planus and similar conditions.

The MELISA blood lymphocyte immune reactivity test appears to be a more accurate indicator of immune reactivity than the patch test. When patch tests are to be used it should be noted that the clinical trials found that mercury immune reactivity is often a delayed reaction, with positive patch test observed only later on the 10th or 17th day of the test. Patients with oral lichen planus also commonly have been found to be immune reactive to gold or nickel so that replacement of gold or nickel crowns may be beneficial in such patients when amalgam replacement is not sufficient to resolve the problem (85).

Oral lichen planus and oral lesions, caused most commonly by reactivity to mercury, are inflammatory pre-cancerous conditions that have been well documented in the literature to often develop into oral squamous cell carcinoma (OSCC) (85). Infection and chronic inflammation have been found to contribute to carcinogenesis through inflammation-related mechanisms (85). Inflammatory bowel diseases are associated with colon carcinogenesis and inflammatory oral conditions such as oral lichen planus (OLP) and leukoplakia are associated with OSCC.

Mercury (as well as toxins from root canals and cavitations) interact with brain tubulin and disassembles microtubules that maintain neurite structure (35, 200, 207b, 258, 303, 437). Thus chronic exposure to low level mercury vapour can inhibit polymerisation of brain tubulin and creatinine kinase which are essential to formation of microtubules. Studies of mercury studies on animals give results similar to that found the Alzheimer brain. The effects of mercury with other toxic metals have also been found to be synergistic, having much more effect than with individual exposure (35).

Teeth are living tissue and have massive communication with the rest of the body via blood, lymph, and nerves. Mercury vapour (and bacteria in teeth) have paths to the rest of the body (34, 325, etc.). Mercury has direct routes from the teeth and gums to the brain and CNS, where it accumulates to high levels in those with a large number of amalgam fillings (34, 327, 329).

Due to galvanism of mixed metals, amalgam fillings produce electrical currents which increase mercury vapour release and may have other harmful effects (14, 19, 27, 28,



29, 30, 35, 47, 100, 192, 600). These currents are measured in micro amps, with some measured at over 4 micro amps. The central nervous system operates on signals in the range of nana-amps, which is 1,000 times less than a micro amp (28). The metals also have electrical potentials which can be measured in millivolts (mV). One clinical study determined that electrical potential differences of over 50 mV were pathological (48b), causing galvanism, leukoplakia, oral lichen planus, or toxic or allergic reactions to restorations (48a, etc.). In most subjects with amalgam fillings, potential differences of more than 50 mV are present between restorations (48a), with potentials ranging from -417 mV to +150 mV. Negative potentials may be more pathological than positive ones. The average potential for metal crowns and bridges was 154 mV and for brace brackets was 74 mV (48a).

Negatively charged fillings or crowns push electrons into the oral cavity since saliva is a good electrolyte and cause higher mercury vapour losses (35, 192). Patients with autoimmune conditions like MS, or epilepsy, depression, etc. are often found to have a lot of high negative current fillings (35). The Huggins total dental revision (TDR) protocol calls for teeth with the highest negative charge to be replaced first (35). Other protocols for amalgam removal are available from international dental associations like IAOMT (153) and mercury poisoned patients' organisations like DAMS (447). For these reasons it is important that no new gold dental work be placed in the mouth until at least 6 months after replacement. Some studies have also found persons with chronic exposure to electromagnetic fields (EMF) to have higher levels of mercury exposure and excretion (28). The post MRI saliva mercury levels for a sample of patients was on average 31% higher after MRI than before (28e).

In a large German study of MS patients after amalgam revision, extraction resulted in 80% recovery rate versus only 16% for filling replacement alone (302, 308). Other cases have found that recovery from serious autoimmune diseases, dementia, or cancer may require more aggressive mercury removal techniques than simple filling replacement due to body burden. This appears to be due to migration of mercury into roots and gums that is not eliminated by simple amalgam replacement, providing a lasting residue for chronic mercury exposure. That such mercury (and similarly bacteria) in the teeth and gums have direct routes to the brain and CNS has been documented by several medical studies (34, 325, etc.).

Periodontal offices also often are a source of exposure to mercury for staff and patients. Both dental hygienists and patients get high doses of mercury vapour when dental hygienists polish or use ultrasonic scalars on amalgam surfaces (240).

Pregnant women or pregnant hygienist especially should avoid these practices during pregnancy or while nursing since maternal mercury exposure has been shown to affect the fetus and to be related to birth defects, SIDS, etc.(38, 61, 272), and breast milk contains up to 6 times higher mercury than in the mother's blood (20, 186). There is considerable exposure as well when polishing amalgam fillings and hygienists are generally advised not to polish amalgam fillings.

The component mix in amalgams has also been found to be an important factor in mercury vapour emissions. The level of mercury and copper released from high copper amalgam is as much as 50 times that of low copper amalgams (191). Studies have consistently found modern high copper non-gamma II amalgams have greater release of mercury vapour than conventional silver amalgams (298). While the non-gamma II amalgams were developed to be less corrosive and less prone to marginal fractures than conventional silver amalgams, they have been found to be unstable in a different mechanism when subjected to wear, polishing, chewing, brushing or bleaching they form droplets of mercury on the surface of the amalgams (136, 182, 192, 297). This has been found to be a factor in the much higher release of mercury vapour by the modern non-gamma II.

Recent studies have concluded that because of the high mercury release levels of modern amalgams, mercury levels higher than Government health guidelines are being transferred to the lungs, blood, brain, CNS, kidneys, liver, etc. of large numbers of people with amalgam fillings and widespread neurological, immune system, and endocrine system effects are occurring (34, 35, 118, 199, 212, 222, 313, 600).

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Note: etc in a list denotes that author is aware of more references on this subject, generally available in (600).

(601) B. Windham (Ed), Annotated bibliography: Level of Exposure to mercury from dental amalgam, 2005, [www.flcv.com/damspr1.html](http://www.flcv.com/damspr1.html)

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