



Mercury induced Dental Amalgam Restoration lead to progressive neural damage along with multifunctional effect on Human Body System – A Scientific Review

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Submission Date: 04 Feb. 2023 | Published Date: 18 Feb. 2023

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Abstract

Mercury in dental restoration produces various known disorders but recent studies emphasize Autism Spectrum disorder (ASD) which is the most unwanted social challenge of expecting parents. Children born after mercury consumption during pregnancy have a combination of defects known as Congenital Minamata disease. The World Health Organization (WHO) report's aware that Mercury (Hg) in amalgam restoration is the crucial cause of human exposure to toxins. FDA also alerts women who are planning to become pregnant that should avoid Silver- mercury amalgam restoration for the reason of Alzheimer's disease or Parkinson's disease, and impaired kidney function. So many recent reports highlight Psychological issues such as depression, anxiety, and suicidal ideation. Our aim is to awaken the clinical eye of dental practitioners to find out the easiest alternatives to dental restoration instead of amalgam.

Keywords: Autism Spectrum Disorder (ASD), Congenital Minamata disease, Silver- mercury amalgam restoration

INTRODUCTION

Dental restoration or dental fillings are treatments used to restore the function, integrity, and sound structure of missing, denatured, or decayed tooth structures resulting from caries or trauma. From the very beginning of dental restoration, the function was the only purpose of restoration but nowadays it includes integrity, and morphology which ensuring aesthetics and provide perfect masticatory function along with periodontal health protection by preventing food lodging. So, it needs such multidimensional restoration. The choice of proper restorative material is still now a dilemma for many dentist's minds. So, Dentists prefer to choose a material that bears strength and longevity for patient satisfaction as well as cost worthy. In certain parts of the world dental practitioners may be the ratio is low are still using silver amalgam fillings in patient teeth ¹. The World Health Organization (WHO) in 1990, which published a report that Hg in amalgam filling is the primary source of human exposure to toxins ¹.

Mercury as a Global Threat

For decades Mercury is considered a global noxious waste. According to the United Nations Environment Programme (UNEP) evaluation global mercury pollution is an unbearable burden². Like UNEP the European Union (EU) has also prioritized mercury-induced environmental effluence^{3,4} as well as strategic evolution has been made en route for an anthropogenic mercury-free global environment². About 16 years back in 2006 eradication of global mercury exposure was validated through the "Dubai Declaration on International Chemicals Management," the "Overarching Policy Strategy," and sanctioned the "Global Plan of Action," in which the main concern is agreed to mercury reduction

^{5,6}. Additionally, the world scientific community conveyed their apprehension through “The Declaration of Brescia on Prevention of the Neurotoxicity of Metals”^{7,8}.

Dental Amalgam

Dental amalgam is a choice of restorative material for the preservation of decayed teeth. Amalgam filling materials consist of a mixture of Hg 50%, Ag 35%, Sn, and other metals 15%. Amalgam filling is a preferable option for all classes' restoration due to high strength durability, good marginal integrity, easily applicable and affordability. But advanced dentistry gives emphasis on mercury vapor release, poor aesthetics, loss of natural tooth structure due to larger cavity preparation, and susceptibility to corrosion⁹.

Dental Amalgam Filling: Health Hazards

It should be noted that epidemiological studies and studies using mercury levels in blood and urine, which do not consider genetic susceptibility factors, autoimmunity reactions, and mercury exposure during pregnancy (amalgam, thimerosal), are not able to detect a statistically significant effect, even if there is one. In September 2020, the Food & Drug Administration (FDA) strictly prohibited the following groups must avoid dental amalgam restoration each and every time conceivable and suitable: pregnant women and their developing fetuses; women who are planning to become pregnant; nursing women and their newborns and infants; children, especially those younger than six years of age; people with pre-existing neurological disease such as multiple sclerosis, Alzheimer's disease or Parkinson's disease; people with impaired kidney function; and people with known heightened sensitivity (allergy) to mercury or other components of dental amalgam¹⁰.

FDA recommended high-risk groups for mercury-induced amalgam restoration¹¹:

1. Children especially those younger than six.
2. Women who are pregnant or planning to be pregnant.
3. Nursing mother.
4. Patients who are suffering from neurological impairment or kidney dysfunction.
5. People who are sensitive to mercury, tin, zinc, and copper.

Neurotoxic Effect of Mercury:

It is found that Autism symptom severity is directly and indirectly associated with Mercury levels in the blood which has a proven relationship with mercury-induced dental amalgam restoration. A neurodevelopmental autoimmune disorder which has been characterized as a disorder of neuronal organization, that is, the development of the dendritic tree, synaptogenesis, and the development of the complex connectivity within and between brain regions' is medically known as Autism Syndrome Disorder (ASD). Autism is identified with a depressed expression of neural cell adhesion molecules (NCAMs), which are critical during brain development for proper synaptic structuring. Organic mercury, which promptly crosses the blood-brain barrier, specially targets nerve cells and nerve fibers; and accumulates at the highest Hg-levels in the brain relative to other organs. What's more, most cells respond to mercurial injury by reducing levels of glutathione (GSH), metallothionein, hemoxygenase, and other stress proteins, neurons tend to be 'markedly deficient in these responses' and thus are less able to remove Hg and more prone to Hg-induced injury. Remarkably during the brain development stage, mercury interferes with neuronal migration, depresses cell division, disrupts microtubule function, and reduces NCAMs¹².

Mercury levels in the brain because autoimmune activation, oxidative stress, neuroinflammation, and ultimately neuronal damage, and loss of connectivity those symptoms eventually caused autism symptoms severity¹³.

Mercury Toxicity with Pregnancy:

Since 1959 in Kyushu, Japan researchers have been proved that the post-effect of methylmercury poisoning causes a high incidence rate of damaged babies births to women who consumed seafood from the contaminated bay, babies with a disease named Minamata Disease basically a result of methylmercury poisoning that affects one's nervous system, mainly central nervous system, is damaged. It is also verified that inorganic mercury poisoning damages kidneys. After consumption of Methylmercury is the form of mercury most often absorbed by the intestines and enters the bloodstream in the human body. During pregnancy, Methylmercury crosses from the bloodstream via the placenta to the baby and passes through the blood-brain barrier and other tissues. Mercury and pregnancy is a disastrous combination for unborn babies because during development their brain and nervous system are extremely subtle to the damages of mercury consequently a child is born with unconquerable congenital Minamata disease with the following stigmata:

- Mental retardation
- Strabismus (squint)
- Neck instability
- Seizures (fits)
- Poor balance
- Microcephaly (small head)

- Lack of eye coordination

Indeed, women with higher mercury levels had children with lower scores on attention, language, and memory tests, and they displayed reduced coordination, speed, and tactile processing¹⁴.

Mercury Poisoning associated with Breastfeeding:

After birth, a baby's brain development is initiated through breast milk nutrition. If a mother consumed mercury or has amalgam fillings then poisonous mercury may be transferred into breast milk which is very susceptible to damage to the brain and nerves¹⁴.

Consequences of Mercury-induced Amalgam Fillings:

A dental amalgam filling continuously releases mercury which is absorbed and retained in the vital organs like the brain, kidney, liver, lung, and gastrointestinal tract. Evidently, mercury release can be exaggerated by the number of fillings and other activities like chewing, teeth grinding, and also during hot liquids consumption. During the placement, replacement, and removal of dental mercury amalgam fillings evaporation of mercury vapor also threaten humans as well the environment. For dental professionals, it must be noticed that an estimated 80% of the mercury vapor from dental amalgam fillings is absorbed by the lungs and passed to the rest of the body, particularly the brain, kidney, liver, lung, and gastrointestinal tract. So, it became a non-biocompatible restorative material. Due to the state of oxidation, mercury deposited in the brain can have a half-life of up to several decades¹⁰.

Several Scientific studies have identified dental mercury as intensifying factor in conditions including Psychological issues such as depression and anxiety, Suicidal ideations, Multiple Sclerosis Periodontal disease Micromercurialism, Autism spectrum disorders, Alzheimer's disease Autoimmune disorders/immunodeficiency, and Reproductive dysfunction¹⁰.

Symptoms most commonly associated with elemental mercury which mainly use in dental restoration have 80% absorption from vapor inhalation. Primary toxicity in lungs, skin, eyes, and gingiva. Secondary toxicity was found in the Central Nervous system and kidney transport in the body, crosses Blood Brain Barrier (BBB), and placenta and is found in breast milk¹⁵.

Dr david Kennedy and Dr Griffin Cole stated in a study the most common association which is described in the table below.¹⁰:

Acro-dynia such as emotional instability, loss of appetite, general weakness, and skin changes	Anorexia	Cardiovascular problems
Cognitive/neurological impairments/memory loss/decrease in mental function	Delusions/delirium/hallucination	Dermatological conditions
Endocrine disruption/enlargement of thyroid	Erethism [such as irritability, abnormal responses to stimulation, and emotional instability]	Fatigue
Headaches	Hearing loss	Immune system impairments
Insomnia	Nerve response changes/decreased coordination/weakness, atrophy, and twitching	Oral manifestations/gingivitis/metallic taste/oral lichenoid lesions/salivation
Psychological issues/mood swings/anger, depression, irritability, and nervousness	Renal [kidney] problems	Respiratory problems
Shyness [excessive shyness]/social withdrawal	Tremors/mercurial tremors/ intention tremors	Weight loss

RECOMMENDATIONS

To date, patients are more concerned about their oral health and aesthetics so Amalgam or metal-induced fillings loosen their demand¹⁶.

Microleakage and marginal adaptability is the common error of mercury-induced Amalgam which led to frequent treatment failure and tooth loss¹⁷.

Unfortunately, scientists confirmed that by 2030, dental amalgam will be the greatest source of environmental mercury pollution¹⁸.

Great valued Composite resin which needs less loss of healthy tooth structure. Newly formulated Smart materials for dental restoration are Composite resins and Glass ionomers. Their modifications like bioactive resin composite are always the better options with high compressive strength and abrasion resistance properties, which would provide aesthetics and functional efficacy. New Glass ionomers have fluoride-releasing anti-cariogenic bacterial properties and are considered a perfect substitute for dentin and suitable base insulators beneath the Composite resins as well as convenient for ease application which helps to regain perfect morphology of tooth and greater finishing^{17,19}.

REFERENCE

- Zaharaa s. al-garawi, Falah s. al-fartusie , Haider j. al-fatlawi . (2015). The Impact role of using Dental amalgam "Silver" fillings on cholinergic and endogenous adrenergic activity; *Int J Pharm Bio Sci* 2015 April; 6(2): (B) 804 – 813.
- United Nations Environment Programme-Chemicals. Global Mercury Assessment. Geneva: 2002. Available at: <http://www.unep.org/gc/gc22/Document/UNEP-GC22-INF3.pdf>
- Commission on the European Communities. Community Strategy Concerning Mercury communication from the Commission to the Council and the European Parliament. Commission on the European Communities; 2005. (Com (2005)20 final.
- European Parliament. Community Strategy Concerning Mercury—European Parliament Resolution on the Community Strategy Concerning Mercury. European Parliament; Strasbourg: 2006.(2005/2050(INI) P6_TA(2006)0078)
- Secretariat for the Strategic Approach to International Chemicals Management. Strategic approach to International chemicals management—Comprising the Dubai Declaration on International chemicals management, the Overarching Policy strategy and the Global Plan of action. Secretariat Strateg Approach Int Chem Manag-UNEP/SAICM; 2006. Available at: http://www.chem.unep.ch/saicm/SAICM%20texts/standalone_txt.pdf
- United Nations Environment Programme. Report of the International Conference on Chemicals Management on the Work of Its First Session; 2006. <http://www.chem.unep.ch/saicm/SAICM%20texts/Final%20ICCM%20report%20Eng.pdf>
- Landrigan P, Nordberg M, Lucchini R, Nordberg G, Grandjean P, Iregren A, et al. The Declaration of Brescia on Prevention of the Neurotoxicity of Metals. *Am J Ind Med*. 2006; 50:709–11.[PubMed: 17036364]
- Bose-O'Reilly S, McCarty KM, Steckling N, Lettmeier B. Mercury exposure and children's health. *Curr Probl Pediatr Adolesc Health Care*. 2010 Sep;40(8):186-215. doi: 10.1016/j.cppeds.2010.07.002. PMID: 20816346; PMCID: PMC3096006.
- <https://www.fda.gov/medical-devices/dental-devices/dental-amalgam>
- <https://iaomt.org/resources/dental-mercury-facts/amalgam-fillings-danger-human-health>
- <https://www.fda.gov/medical-devices/dental-amalgam-fillings/dental-amalgam-fillings-recommendations-graphics>
- Bernard S, Enayati A, Redwood L, Roger H, Binstock T. Autism: a novel form of mercury poisoning. *Med Hypotheses*. 2001 Apr;56(4):462-71. doi: 10.1054/mehy.2000.1281. PMID: 11339848.
- Kern, Janet K.; Geier, David A.; Sykes, Lisa K.; Haley, Boyd E.; Geier, Mark R. (2016). The relationship between mercury and autism: A comprehensive review and discussion. *Journal of Trace Elements in Medicine and Biology*, 37(), 8–24. doi:10.1016/j.jtemb.2016.06.002
- <https://www.webmd.com/baby/what-to-know-mercury-pregnant-breastfeeding>.
- https://www.env-health.org/IMG/pdf/mercury_chapter2.pdf
- <https://www.dentistrytoday.com/alternatives-to-traditional-posterior-direct-restorations/>
- C Satish, C Shaleen, C Girish 2007; Textbook of Operative Dentistry 10.5005/jp/books/10929_20, Microleakage. Jaypee Brothers MP Ltd.2007, 1/e, ISBN 9788180618932, https://doi.org/10.5005/jp/books/10929_20
- Amalgam alternatives: replacing the irreplaceable?. *Br Dent J* 225, 216 (2018). <https://doi.org/10.1038/sj.bdj.2018.676>
- Francois P, Fouquet V, Attal JP, Dursun E. Commercially Available Fluoride-Releasing Restorative Materials: A Review and a Proposal for. *Materials (Basel)*. 2020 May 18;13(10):2313. doi: 10.3390/ma13102313. PMID: 32443424; PMCID: PMC7287768.