Report

Dental amalgam – environmental issues and their solution

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Abstract

Dental amalgam has been a globally used direct posterior restorative material for decades. Mercury, being one of its components, has raised concerns regarding its accumulation in ecosystems. There is a growing pressure for the governments of various countries to reduce the discharge of mercury waste. Various industries, including dental, have given this increased attention and restrictions on the handling and discharge of contaminated waste have been established in several countries. Dental amalgam, when improperly disposed, is both an aquatic and terrestrial hazard. Whereas most countries have identified the problems associated with its use, some are still not aware of the steps and measures that need to be taken. This article is aimed to identify the various steps that can be taken to diminish mercury accumulation. Collecting amalgam scrap through the use of an amalgam capture device and separating amalgam from waste water through an amalgam separator are important measures needed to be taken before recycling begins to ensure recycling projects undertaken in the future will be successful.

Keywords: elemental mercury, environment, amalgam traps, amalgam separator.

Introduction

Dental amalgam is one of the most commonly preferred and used direct posterior restorative materials due to its superior physical and mechanical properties, stability, ease of use and more importantly relatively low cost. However, one of its major components, mercury, is of particular concern due to potential possible harmful effects such as oral galvanism, toxicity, allergy and ecological grievances.[1] Mercury commonly occurs in nature as sulfides and in a number of minerals. From these deposits mercury is circulated naturally in the biosphere. Natural emission of mercury amounts to around 150,000 tons a year. Globally, between 20,000 to 30,000 tones of mercury is discharged by human activities.[2] 10,000 tons of mercury is mined worldwide each year, 5% of which is used in dentistry.

Studies all over the world have shown that mercury concentration is increasing alarmingly in waterways. An example, Vapi in India, was considered the third most polluted place in the world (times.com), where the level of mercury in groundwater was 96% higher than WHO health standard.

Mercury is accumulating in both aquatic and terrestrial food chains, with higher levels occurring in predators[3]. All predators that depend on fish in one form or another are directly or indirectly affected. Mercury is a health and

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environmental hazard, especially for pregnant females and children. Elemental mercury entering the waterways is converted to methyl mercury, mediated by methyl cobalmine or by sediment microorganisms including bacteria and fungi. The subsequent uptake of mercury takes place as a result of mercury's high affinity for sulfur and sulfudryl groups. The food chain facilitates the biomagnifications of mercury levels, when organisms higher in the food chain ingest other organisms contaminated with ethyl mercury. Plankton and algae that take up methyl mercury are consumed by small fish that in turn are consumed by large fish and other predators, thus allowing the accumulation of mercury through the food chain.[4]

Another source where metallic mercury is vaporized into the atmosphere is the cremation of cadavers, notably in countrries like India. The presence of resultant mercury vapor, due to inadequate chimneys in crematoria, facilitates more rapid conversion to soluble forms which are then deposited into the soil and water and eventually enter the food chain. It is estimated that approximately 170 to 180 kg of metallic mercury is emitted into the atmosphere from 50,000 cremations.[5] In order to lessen these effects; crematoria should be equipped with selenium filters that significantly diminish the amount of mercury released. Furtwhermore, the crematoria should not be in densely populated areas and their chimneys should not be close to the ground.

According to a report in Germany, approximately 46 percent of freshly triturated amalgam was placed as new amalgam restorations.[6] India has more than 200 dental colleges producing approximately 15000 dentists every year. Dental amalgam manipulation is taught in first year and amalgam restorations on patients from third year until internship. Thus, taking into account the number of dental practitioners practising with Dental Amalgam throughout the country, the consequent impact on the environment is understandable.

Recycling of amalgam

Amalgam waste, when kept separate from other waste, can be safely recycled. The mercury can be recovered from amalgam waste through a distillation process and reused in new products. The ADA strongly recommends recycling as a best management practice for dental offices.[7] This can be achieved by implementing the following measures:-

Amalgam capture devices:

An amalgam capture device is an apparatus such as a chair side trap, vacuum pump filter or amalgam separator that collects amalgam particles, be it contact or non-contact amalgam. Scrap amalgam in any form is not supposed to be put in red biohazard bags or trash cans. It should not be rinsed down the drain, nor even removed with high speed suction. Extracted teeth with amalgam restorations should not be placed in red biohazard bags. If contact amalgam must be disinfected, heat should not be used, as it will cause the mercury to volatilize and be released into the environment. If scrap amalgam is stored in used radiographic fixer, water, or any other liquid, under no circumstances should the liquid be decanted down the drain.

Amalgam traps:

The control of waste dental amalgam includes proper installation and management of the traps and filters used in dental chair vacuum systems. Disposable amalgam traps are preferable to reusable traps because of the difficulty in effectively removing amalgam particles from the trap without spilling the particles into the drain or garbage. Mesh traps (coarse, medium and fine) at different levels should be installed. Disposable amalgam traps should not be placed in the regular garbage or with medical waste. Precautions, such as glasses, gloves and mask, should be used when handling the chair-side trap. The vacuum system should be flushed with disinfecting line solution before changing the chair-side trap. Research has suggested that some types of line cleansers, such as those that contain bleach, may dissolve mercury from amalgam particles. This would increase the release of mercury into the dental wastewater. Only non corrosive (pH between 6.5 and 9.0), biodegradable and non oxidizing line cleanser should be used to flush the line at the end of the working day. The trap must be changed the next morning before the suction is used. This method will allow the particles in the trap to dry. Traps can be replaceable or disposable both of which need different handling to recover scrap amalgam.

Vacuum Pump Filters:

Do not dispose of used vacuum pump filters in the sharps container, as medical waste, or in regular garbage. Vacuum pump filters should be replaced regularly as recommended by the equipment manufacturer. All the previously used filters should be treated as hazardous waste.

Amalgam Separators:

An "Amalgam separator" is a wastewater treatment device involving sedimentation, filtration or centrifugation, or a combination of these technologies designed to separate amalgam particles from dental wastewater. Dental amalgam separators will remove the maximum amount of amalgam waste and are much more efficient in removing amalgam

from the dental wastewater than filters and traps used in chair-side dental units and vacuum lines. Most amalgam separators can attain an efficiency of 99% removal of amalgam.[8] An amalgam separator should treat all dental facility waters likely to come into contact with dental amalgam waste prior to discharge. This includes wastewater from chair-side water collection units as well as sinks and drains.

Elemental Mercury: (also referred as free, bulk, or raw mercury)

Sources of mercury in a dental office could be electrical equipment with switches, relays or temperature controls (thermostats), mercury thermometers, blood pressure units and free mercury that is amalgamated with silver alloy. All forms of mercury should be collected and stored. It should not be rinsed or disposed down the drain. It should also not be disposed in the dust bin or as a medical waste. A mercury spill should never be cleaned using a vacuum cleaner.

The spilled mercury should be collected using a nitrile glove. Latex gloves should not be used as mercury can penetrate latex. All visible elemental mercury should be cleaned up by using a mercury spill kit. All contaminated items are required to be placed in a sealable plastic bag or container which should be labeled as "Mercury Waste".

Summary and Conclusion

Dental Best Management Practices[7] is a series of amalgam waste handling and disposal practices that include, but are not limited to, initiating bulk mercury collection programs, using chair side traps, amalgam separators and vacuum collection, inspecting and cleaning traps, and recycling or using a commercial waste disposal service to dispose of the collected amalgam. Globally, everyone is getting educated and motivated to understand the importance of implementing eco-friendly measures. Governments of various countries have passed regulations and laws to ensure implementation of these measures. However, in India, there is a lack of statistical data, based on research and surveys, where the problem can be pinpointed. There are still no regulations, nor recycling programs of dental materials used in daily routine, either in private clinics or dental institutes. There is a lack of mercury spill kits, no proper infrastructure for the collection and disposal of hazard waste material, no amalgam separators installed, no guidelines and not even household hazardous waste collection system. To prevent the situation from worsening, the use of simple adaptive measures in the approach of handling dental amalgam is necessary to protect the environment.

References

1. Hartung R, Dinman GD. Environmental mercury contamination. Michigan: Ann Arbor Science Publishers.1972.

2. Berlin M. Mercury. Handbook on the toxicology of metals. Amsterdam: Elseveir Science Publishers, 1986:387-445.

3. Doi R, Ohno H, Harada M. Mercury in feathers of wild birds from the mercury-polluted area along the shore of the Shirauvi Sea, Japan.Sci Total Environ 1984;40:155-167.

4. Kyle JH. Hg in the people and the fish of the Fly and Stricinad River Catchments.Waigani, Papua New Guinea. Office of Environment and Conservation, Central Government Offices, 1981:4-7

5. World Health Organization: International Programme on Chemical safety. Environmental health Criteria 118: Inorganic mercury.Geneva: WHO, 1991.6.

6. Appel HG, Volkel G, Rahimi SI. Environmental pollution by tooth amalgam. Biomed Tech (serc) 1989; 34:242-243.

7. Environmentally responsible dental office: The Oregon Dentist's guide to best management practices of dental waste: April 1988.

8. Fan PL, Batchu H, Chou HN, Gasparac W, Sandrik J, Meyer DM. Laboratory evaluation of amalgam separators. J Am Dent Assoc 2002; 133: 577-589.