MERCURY TOXICITY IN DENTISTRY: A LITERATURE REVIEW

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INTRODUCTION

Amalgam has been ruling as a prime restorative material in most parts of the world for over 150 years[1]. Whilst there is no doubt that Mercury is toxic, there is still no strong proof that carefully prepared and placed amalgam pose a danger to dental patients or personnel, though numerous evidence points towards it. Scientific truth must be completely revaluated and studied before drawing any conclusion. This paper intends to review the voluminous literature that has been published on dental amalgam and the health hazards associated with mercury.

HISTORY

Although the exact date of use of Amalgam is difficult to trace, it was first introduced in France in early 1800.The first dental silver Amalgam was introduced in England by Joseph Bell, and known as "Bell's Putty"[2] .There were numerous controversies regarding its use and success, even at the time it was introduced.

The "First Amalgam War" [3] gradually abated until the classic work of G.V. Black in 1896, brought a change in formulation; many failures associated with Amalgam used earlier were overcome. Amalgam underwent no major changes until 1962, Youdelis, developed high copper alloy with superior clinical performance [4,5]

Eames [6] fathered the "minimal mercury technique, using 50:50 mercury alloy ratio with mechanical trichurator in amalgamator.

THE AMALGAM CONCERN : REALITY Vs ISSUES

During the past decade medical research has demonstrated that Mercury is continuously released as vapour into month, air, inhaled, absorbed in body tissues, oxidized to ionic Hg and finally covalently bound to cell proteins.

Countries like Sweden, Denmark and Germany have proposed restrictions on dental amalgam use whereas U.S. Public Health Service believes it is inappropriate at this time to recommend any restrictions.

In assessing the safety and possible risks of dental Amalgam, we need to look at all the possible evidences like: a) Mercury release form dental restoration b) Absorption into body c) Its accumulation, half life and excretion and finally d) Relationship to any possible ill effects.

A) MERCURY RELEASE FROM DENTAL RESTORATIONS

Mercury is mainly released during placement (insertion, condensation, and carving) and removal of Amalgam and can be measured in expired air and saliva [7,8]. Removal of Amalgam can result in evolution of both mercury

vapour[9,10] and mercury containing Amalgam dust[10,11]·Mayer [9] found 2.0 ìg [9,12] of Mercury released on 5th day from conventional Amalgam and 0.5 ìg [9,12] from High copper Amalgam.

"During the functional life of restoration small amounts of Mercury are released in the form of Mercury vapour or Mercuric ions but below the threshold for general population 1 ìg / m^3 [13]".

B) MERCURY ABSORPTION INTO BODY

Mercury is absorbed in many forms in the body, highest as vapour from lungs, 80 % [10], 10 % [14] from all forms from the GI tract, no direct evidence for oronasal cavity to brain [15,16] also through mucous membranes[17], through gingiva [12,18] as Amalgam tattoos or absorption from corrosion of subgingival restorations [19] and even reported to be absorbed as metal and ions from base of cavity into pulp [20].

C) ACCUMULATION, HALF LIFE AND EXCRETION

Mercury form Amalgam can pass from the blood to body organs widely in short term [17], and only measurable in the kidneys in longer term [21], as a result of its ability to complex with metallo-thionine and selenium. Complexing with these components greatly reduces the toxicity and protects body from damage.

- Mercury level in urine - 0.57 - 1.66 ìg /ml [13]
- Mercury level in blood - 0.6 - 19 ng/ml[13]

D) RELATIONSHIP TO ANY POSSIBLE ILL EFFECTS

The major concerns have been:-

1. Kidney dysfunction
2. Neurotoxicity
3. Reduced immuncompetence
4. Increased still birth and birth defects.
5. Hypersensitivity and allergic reactions
6. General Health

KIDNEY DYSFUNCTION

For industrially exposed workers', corresponding allowable maxima are 4 ng/ml for blood,[8,12] and 15 ìg /lit for urine [8,12] (close to 20 ìg /lit, which is considered as "international upper limit" for normal concentration in urine). With regards to normal persons, the values have come between 0.6 - 1.9 ng/ml for blood [8,12] and 0.57 ìg - 1.66 ìg /lit for urine [(9,12)] (well below 'acceptable' and 'normal' levels of 30 ng/ml and 10 ìg /lit respectively). Studies indicate that evidence of 'Altered Renal Function' doesn't appear until urinary mercury concentration is 25 times that attributable to dental amalgam restoration. [22]

NEUROTOXICITY

The claims that Mercury, from dental amalgam could be a factor in the development of Multiple Sclerosis like symptoms are based with very little evidence. Chronic toxic exposure may lead to early manifestations such as: weakness, fatigue, and anorexia and weight loss whereas, late symptoms may be tremor, excitability, amnesia, and ataxia[23] .In fact the similarities between the symptoms of Multiple Sclerosis and inorganic mercury intoxication [(8,12)] and the geographical distribution of Multiple Sclerosis could be attributable to this belief that Mercury is a neurotoxin speculated to play a role in the pathogenesis of Alzheimer's disease, though no evidence proves it. Saxe S R et[24] al have concluded in their article that the mercury in dental amalgam restoration is not a neurotoxic factor in the pathogenesis of the Alzheimer's disease.

REDUCED IMMUNCOMPETENCE

Although there is no indication that Amalgam restoration is responsible for reduced immunity, Egglestone [25] has reported that number of T-lymphocytes appeared to increase when Amalgam restorations were removed, but, however, gave no information on the method of counting the cells and did not take account of intra subject variability.

INCREASED STILL BIRTH AND BIRTH DEFECTS

An ADA survey over 10 years obtained health and pregnancy histories of the female dental surgery assistants and wives of the dent list with more than 20,000 [26] in each group showed no differences in the rate of spontaneous abortion or non congenital abnormalities in children exposed to either high or low levels of Mercury in the dental environment.

HYPERSENSITIVITY AND ALLERGIC REACTIONS

Hypersensitivity to Metallic Hg is uncommon and rate is below 5 % and manifests as a delayed contact Hypersensitivity, however, some individuals may develop Lichenoid type of reactions [27].

GENERAL HEALTH

Study carried out by Ahlqwist et.al [28] shows that there is no stastistically significant correlation between dental amalgam and the incidence of diabetes,myocardial infarction, stroke or cancer. Similarly Wahl MJ[29] clearly stateed that mercury from dental amalgam restoration cannot be linked to kidney damage, Alzheimer's disease, multiple sclerosis, other central nervous system disease including "amalgam disease", mental disorder,damage to immune sustem , increse in antibiotic resistance or harmful reproductive effect.

AMALGAM AND THE ENVIROMENTAL CONCERN

The enigma of Amalgam in dentistry is inextricately bound up with knowledge, truth, rights and health. The intensity of the growing public concern over the continued use of Amalgam as a dental restorative material in countries such as Sweden, Denmark are based entirely on environmental concern and not just on the potential health to dental patients[7]. The contamination of sea water occurred as a result of draining industrial waste from acetaldehyde factories, pollution emanating from the country's paper mills and chlorine - alkali industries. Also another major cause of mercury contamination in the food chain was the use of methyl mercury coated seed which showed deposition of mercury in feathers and other keratinous tissues in birds and analysis and also in sea water fishes. This led to an increase of Hg level in foodstuffs such as eggs, sea food & fishes by 2-4 times higher than identical products in Europe[7]. If this is true, it would be illogical to discontinue the use of dental Amalgam for pure environmental reasons!

Craig *et al* has reported that

Intake of mercury from food stuff = 0.005 mg per day on average).
Source of Hg form water = 0.001 mg/day
Source of Hg from Atmosphere = 0.005 mg/day
Patient with numerous AgF restorations = 0.001 mg/day

(Source, Textbook Dental Materials by Craig .O. Brein).

So in context of Nepal, the patient can be least affected by Mercury toxicity from environmental conditions for various reasons such as less prevalence of industries and alkali like products contaminating environment. The absence of ocean, being land locked country, makes us less susceptible ingestion of sea food or precisely fish from polluted sea water containing high level of methyl mercury which is the most toxic form of Mercury intake

ALTERNATIVE DENTAL RESTORATIVE MATERIALS

Considering the physical properties of Amalgam restoration and their established durability, suitable alternative materials for the restoration of large lesions on posterior teeth are yet not available. Also allergic reactions are possible with synthetic resin restorations or their components and dental gold alloys. The material least likely to produce allergic reactions is fused porcelain, but is too expensive compared to Amalgam, and allergic response to cements used for its placement is possible.The only problem with silver amalgam is that it is unesthetic but its clinical performance and effectiveness are unsurpassed by other restorative materials.

VIEW OF THE AMERICAN DENTAL ASSOCIATIONA AND EUROPEON UNION

American Dental Aossociationa and European Union has not yet banned the amalgam restoration.

RECOMMENDATIONS

If these factors could be controlled in preventing the environmental pollution, then Amalgam from restorations would be the only possible risk factor, and that, too, can'be controlled if the following recommendations in Mercury hygiene are practiced[r2]:

1. Store mercury in unbreakable, tightly sealed container in cool place because mercury has a high vapour pressure i.e. increase temperature will decrease the size of the mercury droplets.
2. Use no touch technique for handling the amalgam.
3.]se tightly closed capsules during amalgamation. Single use capsules containing measured amount of mercury and alloy'as recommended because it eliminates mercury dispenser as well as prevent from possible spillage.
4. Work in well ventilated space.
5. Avoid carpeting dental operatories because decontamination of carpeting is very difficult.
6. Avoid heating mercury or amalgam. Avoid baseboard heaters because spill collected at the edges of room with high temperature will raise the mercury vapour level above the safe limit.
7. Water spray & high volume evacuation should be used when removing old amalgam restoration and finishing new one.
8. Ultrasonic condenser should not be used to avoid mercury vapour release.
9. Salvage all the amalgam scrap and store it under water that contains sodium thiosulfate such as x-ray fixer.
10. Spilled mercury should be cleaned up. The convenient way is swab the floor of office with a chemical marked as mercury absorbs.
11. Face mask should be used to avoid breathing amalgam dust or any other metal dust.
12. Regular monitoring of mercury vapour level in operatories & office.
13. Perform yearly mercury determination on all personnel regularly employed in dental office.
14. Alert all personnel who handle mercury, potential hazards of mercury vapour and necessity for observing good mercury hygiene practices.

CONCLUSION

Among other conclusion, the following quotes were noteworthy[22].

1. Dental amalgam has been used as a dental restoration material for over 150 years. Amalgam remains popular because it has superior physical characteristics, longevity, low cost and ease of use compared to alternative restorative materials.
2. The removal of any dental restoration should be based on sound scientific criteria the extensive removal of dental restoration poses potential risk to the oral and general health of individuals.

3. Available data are not sufficient to indicate that health hazards can be identified in non occupationally exposed persons.
4. Minute amount of mercury do not cause demonstrable adverse effects of significance to the general public.
5. Local allergic reaction is exceedingly rare and when they occur they can be eliminated by the substitution with another material.
6. Systemic toxic effect caused by mercury from dental amalgam are not available in the scientific literature.

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