Use of mercury-containing dental restorations (Dental Amalgam) in Pakistan

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Introduction & background

Dental amalgam has been used for over 150 years for the treatment of dental cavities and is still used world-wide in particular, for the treatment of larger cavities due to its:

- Excellent mechanical properties
- Durability,
- Cost-effectiveness
- Less technique sensitive.
- Long service

Dental amalgam is a combination of silver alloy particles and mercury and contains about 50% of mercury in the elemental form.
Use of Dental Amalgam

It constitutes 75% of all restorative materials used by dentists worldwide.

About 180 million Americans are having more than one billion restored teeth and majority of these are dental amalgam

Mercury issue and Dental Amalgam
Amalgam war

In 1845, the American society of dental surgeons condemned the use of all filling materials other than gold as toxic, thereby igniting the 1st Amalgam war.

- Dodes JE. The amalgam controversy-an evidenced based analysis; JADA vol.132; march 2001.
Controversy on the use of dental amalgam reappeared again in 1926 and into the 1930’s, when a German physician Dr. Alfred stock, demonstrated that mercury escaped from fillings in the form of dangerous vapour that could cause significant medical damage.

This led to the 2nd Amalgam war.

- Dodes JE. The amalgam controversy-an evidenced based analysis; JADA vol.132; march 2001.
A neurobiologist Mats Hanson in 1981, started the fight against authorities and had led the 3rd Amalgam war.

• Dodes JE. The amalgam controversy-an evidenced based analysis; JADA vol.132; march 2001.
The Amalgam war continues to range on today.
Due to its common use in dental practice amalgam is major source of Hg usage. It emits the mercury and emission takes place during:

- Mixing/trituration (mercury vapors)
- Condensation of amalgam filling into cavity (releasing of mercury vapors into environment/air)
- Chewing (increases body burden of mercury of patient)
- Removal of old amalgam filling (increases body burden of mercury of the patient)
- Disposal in waste (increases level of Hg in water, soil and air)
- Autoclaving/heat sterilization of amalgam-contaminated instrument

Among these, **two are more critical situations** in terms of release of mercury from dental amalgam

1. During mixing of Hg with alloy
2. During removal of old amalgam

*Both lead to high exposures to *respirable amalgam particulate* and as well as to *mercury vapor***

These vapors of mercury released from the dental amalgam can be inhaled and rapidly absorbed and distributed throughout the body, accumulating in organs and fetus also.

The mercury can also be transferred to breast milk in proportion to maternal dental amalgam load

In the body mercury mostly target the neuron specially developing neurons and may impair the neonatal growth of the infants of mothers having amalgam restoration.

Germany and Canada advised against the use of dental amalgam in pregnant women and children

Chronic mercury exposure

The mercury is excreted from the body through urine and feces. With the time the elimination may be slow down due to disturbance in the function of detoxification enzyme this lead to increase retention of mercury in the body and may cause unpredictable toxicity.

• There is no question that dental amalgam release Hg. But whether the amount of released mercury is at safe level or not?
• And whether the safety threshold differs among subpopulations?

Risk assessment

According to the World Health Organization, the typical absorbed dose of mercury from amalgams is 1–22 µg per day, and most of the people are suffering from less than 5 micrograms per day.

The FDA believes that the actual exposure is 1–5 µg/d in its current amalgam rule [PHS 1993 (as cited in FDA 2009)].

The level is well below to cause any adverse effect.
The Exposure variables may include:

- Total amalgam surface area.
- Physical and chemical composition of the amalgam.
- Mechanical stresses of chewing and bruxism
- Oral conditions of temperature & pH
Mercury vapors

US Environmental Protection Agency (EPA) provides a reference concentration (RfC) for chronic mercury inhalation of 0.3µ/m3 or /day, which was set in 1995 (EPA 1995).

Mercury vapors

Whereas the California Environmental Protection Agency (CaLEPA) gives the reference exposure level (REL) for chronic mercury inhalation of 0.03 µg/m³ or /day—which was set in 2008,

The FDA and the American Dental Association (ADA) are continuously supporting the dental amalgam as a safe and effective material for dental restorations.

Intro/mercury issue

The US Food and Drug Administration (FDA) advocates the use of dental amalgam and its report on resolving the mercury issue clearly acknowledge that mercury released from dental amalgam is of low level than safety threshold.

The verdict of ADA is so clear and loud that Amalgam is valuable, viable and safe choice for dental patients-ADA;2009.
There are two well-known clinical trials which supported the use of dental amalgam


There was no difference found in both trials in term of neurobehavioral outcome between the amalgam group and the composite (non-amalgam) group—although in both trials the amalgam group showed a statistically significant increase in urinary mercury levels.

Whereas, In 2011 Geier et al reanalyzed the mercury exposure and its level in patients body. This time they used an exposure metric based on amalgam size and years of exposure— And found a significant association between amalgam and the porphyrin biomarkers for mercury-related enzyme blockage. This association suggests that amalgams are a significant chronic contributor to mercury body burden.

In 2013 they also found a significant association between amalgam and a biomarker for kidney damage in the same genetically susceptible subpopulation.

In October 2013, more than 140 (incl Pakistan) nations signed the a well known Minamata Convention, and released an agreement to:

- Set the legal binding measures to curb the mercury pollution
- To discourage the use of dental amalgam via some strategies and programs
- To promote the alternatives to dental amalgam

Amalgam alternatives

Properly placed resin-composite is as durable as amalgam according to a recent meta-analysis

Controversy remains regarding the ingredient in resin-based composite called bisphenol A (BPA), which is under investigation as an endocrine disruptor.

A 2010 World Health Organization report found that BPA from dental materials is unlikely to contribute substantially to chronic exposure.

Our Study

Entitled

Use of mercury-containing dental restorations (Dental Amalgam) in Pakistan
Methodology

• A task oriented questionnaire was designed to extract the information regarding the frequency of use of dental amalgam restoration and its handling and waste management.

• This survey was conducted from 15\textsuperscript{th} August 2014 to 30\textsuperscript{th} September 2014.
Data Collection method

• Questionnaire was filled on telephonic conversation with the consent and appointment taken from the Head of Institute or HOD of Operative Dentistry Department.

• There are 40 Dental Colleges (11 are public sector and 29 private sector) and all were contacted but from 11 public sector only 8 responded where as from 29 private sector 15 responded.
Objectives

• To assess the frequency of use of dental Amalgam in relation to resin based composite.

• To assess the methods of trituration and waste management in Dental Institutes (private and public sector) of Pakistan.
Results and Discussion
- Number of Amalgam & Composite restorations done in public sector dental colleges and hospitals per day
Number of Amalgam & Composite restorations done in private dental colleges and hospitals per day.
Frequency of use of dental amalgam in relation to resin based composite

• According to this survey amalgam is still more frequently used and taught in the Dental Institutes of Pakistan.

• These results are similar with the previous local studies.

• Mumtaz R, Khan AA, Noor N, Humayun S. Amalgam use and waste management by Pakistani dentists: an environmental perspective. EMHJ 2010.

• Kefi I et al. Dental amalgam: effects of alloy/mercury mixing ratio, uses and waste management. J Ayub Med Coll Abbottabad 2011;23(4)
Reasons

- Patients’ financial constraints (inexpensive).
- Considered more durable.
- Less technique sensitive.
- Less financial burden on Institute.
- More promoted in Dental curriculum.
• Interestingly in our study the use of resin composite is found more in private sector Institutes as compared to Dental Amalgam.
• These results are contradictory to other local studies as cited earlier.
• The reason could be that previous studies were not conducted on basis of separate private and public sector Institutes.
The reasons for more frequent use of amalgam in public sector and composite in private sector could be that in public sector the dental treatment provided free of cost or on subsidized rate in community. As amalgam is cheaper than composite that’s why it is selected by public sector Institutes where as in private sector treatment is provided on cost basis.
Method of Trituration used Dental Colleges & Hospitals.

- 55% combination
- 25% Encapsulated
- 20% Hand mixing
Assessment of the methods of Trituration

• According to this study frequency of used method of mixing is combination of hand mixing and encapsulated.

• This may be due to that the encapsulated form is used by post graduate student and faculty members where as hand mixing method is used by undergraduates.

• Mumtaz R, Khan AA, Noor N, Humayun S. Amalgam use and waste management by Pakistani dentists: an environmental perspective. EMHJ 2010.

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Methods of disposing of Amalgam Waste

- Sink: 30%
- Coloured bottle: 20%
- Bin: 70%
- Proper recycling method: 10%

SDPI's seventeenth Sustainable Development Conference
10/12/2014
Assessment of the methods of waste management

• In our study the most frequently used disposal method of Amalgam is by **bin**. These results are in similarity with other local studies.
• The reasons could be that the issue of mercury is not much emphasized in Dental curriculum.
• Student are not well-trained to handle the mercury safely.
• Less awareness among dentist about the proper management of mercury disposal.

Recommendations

A scientific committee may be formed to:

• Initiate the scientific research on environmental risks and indirect health effects from use of dental amalgam and identified a number of lacunae that need to be addressed.

• Communicate various stake holder including parliament, PMDC & HEC and PDA to make law & legal bindings regarding use of mercury in dentistry in particular its handling and disposal and changes in the BDS curriculum.

• Take measures to reduce the mercury levels both in relation to human exposure and the environment.
• Identify the most priority actions to be undertaken.

• Promote the use of cost-effective and clinically effective mercury-free alternatives for dental restoration.

• Organizing scientific conferences, hands-on workshops and training programs on proper handling of mercury during amalgam restoration and its removal and waste management.
Thank you