

Mercury Hygiene Practices followed in Dental Clinics in Pune: A Survey

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ABSTRACT

Introduction: Amalgam has proved to be among the most versatile and durable of all restorative materials. Mercury in various forms has been found to be toxic. Dental personnel can be exposed to mercury in myriad ways like direct skin contact or exposure to mercury vapors through spillage or during various steps of restoration. Proper storage and recycling of waste amalgam has been a challenge. Waste amalgam and spent capsules may be disposed of in the general office refuse and they later enter municipal dumps or incinerators.

Along with the need for amalgam recycling, the knowledge of the dentists about the deleterious effects, method of handling, effective storage and efficient disposal of amalgam scrap is vital. It was felt that the method used by the third party agency for disposing amalgam scrap should be mentioned.

Materials and methods: A confidential questionnaire was formed of close- and open-ended questions regarding the awareness of toxic effects of mercury, its handling and storage prior to disposal. This was distributed randomly to 100 private practitioners in Pune city, Maharashtra state, India. A response rate of 75% was obtained. The results were analyzed.

Results: All the dentists surveyed were aware of the toxic effects of mercury. Thirty-four percent were storing the scrap in the ADA-recommended method, 23% were replacing more than 5 to 10 amalgam restorations with esthetic alternatives per week, 32% used high volume evacuation while removing old fillings and 94% of them had evacuation into the common drain without any recapture systems.

Conclusion: We need to develop a comprehensive waste management plan for the disposal of amalgam scrap. Guidelines need to be established not only among the dentists but also with the waste disposal agency. This will go a long way in reducing the deleterious effects of mercury in the environment.

Keywords: Amalgam scrap, Mercury hygiene, Amalgam waste disposal.

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INTRODUCTION

Similar to all the materials in the world, mercury has the potential to be hazardous if not managed properly. Mercury is ubiquitous in the environment and is taken into the body in one form or another via water, air and food on a daily basis. The health risk is clearly greater for members of the dental office team than a patient. Careful review of amalgam

handling procedures reveals that the critical time for health concerns is when metallic mercury exists in liquid or vapor form, rather than when found in a set amalgam restoration. This is because mercury in liquid or vapor form can be absorbed through the alveoli in the lungs at 80% efficiency and through the gastrointestinal tract at efficiencies of 0.01% (elemental), 7% (inorganic), 95 to 98% (organic).¹

In a dental office the sources of mercury exposure related to amalgam include:

1. Amalgam raw materials being stored for use (usually precapsulated packages)
2. Mixed but unhardened amalgam during trituration, insertion and intraoral hardening
3. Amalgam scraps that has insufficient alloy to consume the mercury present completely
4. Amalgam undergoing finishing and polishing operations, and
5. Amalgam restorations being removed.²

REVIEW OF LITERATURE

Even though amalgam has been used as a restorative material for over 180 years, there has always been a controversy regarding the toxic effects of mercury on the body. There are studies conducted in the United States and Europe regarding the mercury hygiene practices adopted by dental practitioners.³⁻⁵ There has been studies reviewing the documented association between mercury and systemic disorders.⁶ A recent survey conducted in Ajman, UAE, evaluated the waste management practices adopted in 52 dental clinics.⁷ They found that most of the dentists were unaware of the proper protocol of disposal of hazardous waste. A noteworthy study evaluated the mercury exposure that occurs in dental practices.⁸

Studies and surveys in India evaluating the mercury hygiene practices are rare. Knowledge of the mercury hygiene practices adopted by dentists is essential to formulate a protocol of waste management by the health department. Addressing this concern, it was proposed to undertake a survey among dentists in Pune with regard to their knowledge of mercury toxicity and amalgam scrap disposal. The biomedical waste generated in the dental office is given to a third party agency designated for that purpose by the health department. It was proposed to enquire about the methods employed by the agency to dispose or recycle

the amalgam waste. The findings of such a study will give an insight into the waste management practices employed by dentists as well as their awareness about the toxic effects of mercury.

MATERIALS AND METHODS

The objectives of this study were to find out:

1. Areas in the dental office where there is more chances of exposure to mercury.
2. Common procedures where there is chance of exposure to mercury (patients as well as the clinician).
3. Awareness of dentists regarding mercury hygiene.
4. Practices followed by dentists regarding mercury hygiene and amalgam scrap disposal.
5. Awareness of waste disposal agencies about mercury hygiene practices.

METHODOLOGY

A structured format survey consisting of nine close-ended questions and one open-ended question were distributed to a random selection of 100 private practitioners in Pune. The completed survey forms were collected in person, by post or through e-mail. There were a total of 75 completed forms received which came to a response rate of 75%. The identity of these participants was kept confidential. Information was collected from the biomedical waste treatment facility for the Municipal Corporation, Passco Environmental Solutions, Pune, about their segregation and disposal methods for amalgam scraps collected from dental clinics. The results were tabulated (Survey Questionnaire Attached).

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1. Are you aware of the potential toxicity from mercury during placement/removal of amalgam restoration?
a. Yes b. No
2. According to you, which form is mercury more toxic to the dentist?
a. Vapor b. Solid c. Liquid
3. Are you aware of the critical threshold for mercury vapor level in the dental office? If so tick the closet value (taking an average of 40 working hours per week)
a. 50 µg/cubic m b. 0.05 µg/cubic m c. 50 µg/cubic m
4. In what form are you giving amalgam scrap to the waste disposal agency? (Please specify)

5. How often do you place amalgam restorations in your clinics?
a. Less than 5 restorations per week b. 5-10 restorations per week
c. 10-15 restorations per week d. More than 20 restorations per week
6. How often do you replace silver amalgam restoration with any other tooth colored restoration?
a. Less than 5 restorations per week b. 5-10 restorations per week
c. 10-15 restorations per week d. More than 20 restorations per week
7. Do you use suction while removing amalgam scrap? If so, mention the type of evacuation method used.
a. Saliva ejector b. High volume evacuation
Any other _____
8. The evacuation system of your dental chair opens:
a. To the common drain b. Any other please specify
9. Is your dental clinic air-conditioned?
a. Yes b. No
10. Where is the amalgam scrap stored in your clinic?
a. In a bottle
b. In a bottle with water
c. In a bottle with used fixer solution

Any other comments/suggestions:

The following information is optional:

Your name: _____

Designation: _____

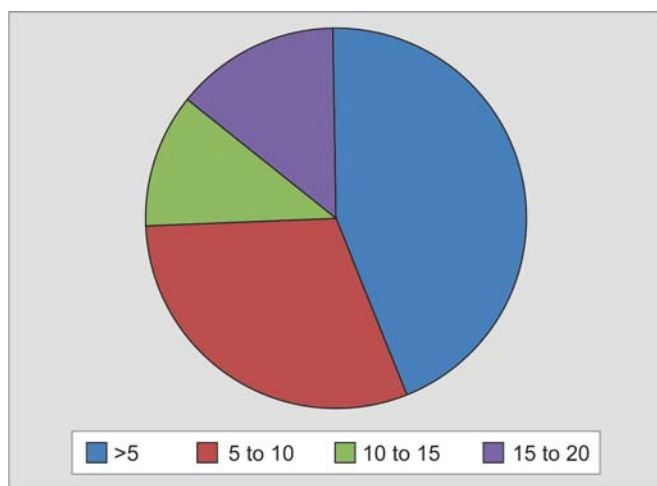
Number of years in practice: _____

Thank you very much for sparing your time. Best wishes!

RESULTS

One hundred percent of the dentists were aware of the potential toxicity from mercury during placement/removal of amalgam restoration. Seventy-six percent of the dentists were aware that the vapor form of mercury is more toxic, 20% said in liquid form and 4% said that solid form of mercury is more toxic. Ten percent of the dentists selected 150 µg/m³ to be the critical threshold for mercury vapor level, 30% of dentists selected 0.05 µg/m³ and 29% selected the correct threshold level (taking an average of 40 hours per week).

Thirty percent of the dentists stored the scrap under water, 34% in a bottle with used fixer solution, 6% gave the amalgam scrap in biomedical waste bags to the waste disposal agency, 3% gave the amalgam scrap in plastic bags to the waste disposal agency and 2% of the dentists throw amalgam scrap in the dustbin.



Graph 1: Amalgam restorations/week

Forty-three percent place less than five amalgam restorations per week, 30% place 5 to 10 amalgam restorations per week, 11% place 10 to 15 amalgam restorations per week and 14% place 15 to 20 amalgam restorations per week (Graph 1). The high-risk category of dentists will be around 25%. Sixty-three percent replace less than five amalgam restorations per week, 23% replace 5 to 10 amalgam restorations per week, 4% replace 10 to 15 amalgam restorations per week and 4% replace 15 to 20 amalgam restorations per week with any other tooth colored restorations. Fifty-five percent of dentists use saliva ejector type of evacuation system and 32% use high volume evacuation.

Ninety-four percent of dentists' evacuation systems open into the common drain with absence of any recapture systems. Sixty percent dentists have an air-conditioned dental clinic.

DISCUSSION

Mercury has a potential to be hazardous if not managed properly. The alloying reaction of mercury with silver tin alloy should go to completion to ensure less of free mercury. Scrap amalgam management is quite important because the mercury content may prove hazardous raising environment concerns if not stored and disposed properly. This study aimed at evaluating the knowledge of a cross-section of dentists in Pune regarding the toxicity, threshold value and methods of disposal of amalgam scrap.

According to our study, 100% of the dentists were aware of the potential toxicity from mercury. The health risk is clearly greater for members of the dental office than a patient. Careful review of amalgam handling procedures reveals the critical times for health concerns when the metallic mercury exists in liquid or vapor form, rather than when in found in set amalgam restorations. As this can be

inhaled and absorbed through the alveoli in the lungs at 80% efficiency and 0.01% (elemental), 7% (inorganic), 95 to 98% (organic) in gastrointestinal tract.¹ It is difficult, if not impossible to contain liquid or gaseous mercury totally because it is very mobile, has a high diffusion rate, and penetrates through extremely fine spaces. Even in packages that include plastic blister wrapping and layers of cardboard, mercury vapor leakage is possible. During amalgam trituration, small amounts of material may escape from capsules. While removing old restorations some amount of mercury vapor may also escape. The ADA recommendation for the critical threshold level for exposure to mercury vapor is $50 \mu\text{g}/\text{m}^3$ for a 40 hours work week.⁹ Most of the dentists surveyed were aware of the mercury toxicity in vapor form but measures taken to remedy the same was inadequate.

While performing restorative procedures, isolation procedures are commonly followed. They may be in the form of saliva ejector (low volume evacuation system) or a high volume evacuation system. Amalgam debris may include large particles ($100 \mu\text{m}$), medium-sized particles ($10\text{-}100 \mu\text{m}$) and fine material ($<10 \mu\text{m}$). ADA recommendations say that removal of amalgam fillings should be done under strict isolation with high volume evacuation.⁹

Replacing amalgam restorations with any other material could be due to esthetic requirements, failure of the amalgam filling or concerns regarding toxicity of amalgam. Our survey quantified the number of dentists performing such a procedure. This toxicity can be reduced by use of high volume evacuation.¹⁰ Surprisingly, a very less percentage of dentists were using this method. This could be due to the lack of awareness about the vapor toxicity of mercury and inefficiency of the saliva ejector in this regard.

Amalgam waste products can also be a part of the operatory air. Adequate fresh air should be mixed with existing office air and the dental office should be well ventilated. This is of particular interest when nowadays most of the dental offices are air conditioned. Work should be done in well-ventilated spaces with fresh air exchange and outside exhaust. If spaces are air conditioned, air conditioner filters should be replaced periodically. Due to constraints of space, adequate ventilation in many cases was not present. Alternative ways of assuring air exchange needs to be reviewed, especially when considering the fact that 60% of clinics in our survey were air conditioned.

ADA specifications recommend storing scrap amalgam from restorative procedures under water, glycerin or spent X-ray fixer in a tightly capped jar.⁹ The jar should be nearly filled with liquid to minimize the space where mercury vapor can collect. In our survey, 31% of dentists were storing

amalgam scrap in the ADA recommended method,¹¹ i.e. under spent X-ray fixer solution. Even though availability of spent fixer is adequate in the dental office, there is a lack of knowledge among the dentists about this storage method.

According to ADA regulations, mercury contaminated materials should not be placed in medical waste bags because these are burned and mercury becomes vaporized.¹¹ Our results showed that 3% gave the amalgam scrap in plastic bags to the waste disposal agency and 2% of the dentists throw amalgam scrap in the dustbin.

Concerns about mercury entering into the municipal sewage lines are proven. Dental mercury wastewater contributions should be measured in terms of volumes. The detection limit for mercury in water is 0.02 µg/l according to the EPA standards.¹⁰ ADA recommends use of intraoffice recapture systems, i.e. separators with filters, mercury plating approaches or ion exchange technologies to limit the amount of mercury that escapes into the sewage water lines.¹² Our survey shows a different picture.

The importance of this survey lies in the fact that even though all the dentists were aware of the toxicity of mercury, either to themselves or the patients or the environment, there is a lack of uniformity in following the recommended guidelines. Release of mercury into the environment through the water lines is a cause of major concern, especially because the half-life of mercury is 55 days. The biomedical waste disposal agency has no guidelines about the collection of amalgam scrap from the dental offices or the treatment of the collected scrap (verbal communication with the office of Passco Environmental Solutions, Pune).

A comprehensive, long-term study about the mercury hygiene practices employed among the practicing dentists is the need of the hour. Special emphasis should be given to the guidelines to the biomedical waste disposal agency by the health department in the collection, storage and disposal of amalgam scrap.

CONCLUSION

Silver amalgam is an integral part of a dental practice since 180 years. Even though there have been reported allegations as to the toxicity of mercury there are lot of studies which have conclusively proved that correct handling and disposal of amalgam scrap will make the toxicity negligible. Although developed countries have successfully managed to establish comprehensive systems for waste management, developing countries still suffer from improper waste disposal, insufficient financial resources, lack of awareness

of health hazards and lack of data on health care waste generation.⁶

This study can be thought of as the beginning of a more indepth research that can be performed in the future regarding the issue of dental waste management. A collective effort has to be made at the national level to reduce the effects of toxic mercury wastes to the environment and to address these in comprehensive, effective ways. A responsible dental office can help in restoring a healthier environment and can make a difference.

REFERENCES

1. Bayne SC, Thompson JY. Biomaterials. In: Roberson TM (Ed). Sturdevant's art and science of operative dentistry (5th ed). St Louis, Missouri: Mosby Elsevier 2006:162-72.
2. Spencer AJ. Dental amalgam and mercury in dentistry. Aust Dent J 2000;45:224-34.
3. Maximizing voluntary reductions in dental amalgam mercury. Survey of Springfield dentists and wastewater effluent treatment plants. EPA#E0000127, University of Missouri, Nov 2007.
4. World Health Organization. Review of health impacts from microbiological hazards in health care wastes. Geneva, Switzerland: World Health Organization 2004.
5. Al-Khatib IA, Monou M, Mosleh SA, et al. Dental solid and hazardous waste management and safety practices in developing countries: Nablus, Palestine. Waste Manag Res 2010;45:436-44.
6. Feuer G, Stephen Injeyan H. The dental amalgam controversy: A review. J Can Chiropr Assoc 1996;40(3):169-79.
7. Hashim R, Mahrouq R, Hadi N. Evaluation of dental waste management in the emirate of Ajman, United Arab Emirates. J Int Dent Med Res 2011;4(2):64-69.
8. Adesgaoglu A, Omurlu H, Ozcagli E, et al. Mercury exposure in dental practice. Oper Dent 2006;31:666-69.
9. American Dental Association Council on Dental Materials, instruments and equipments. Dental mercury hygiene: Summary of recommendations in 1990. J Am Dent Assoc 1991;122:112.
10. Dental mercury hygiene recommendations. ADA Assoc Rep 2003;134(11):1498-99.
11. American Dental Association. Best management practices for amalgam waste. Am Dent Assoc Rep 2007 Oct.
12. Batchu H, Rakowski D, Fan PL, Meyer DM. Laboratory evaluation of Amalgam Separators. J Am Dent Assoc 2006;137:999-1005.

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