

## ORIGINAL RESEARCH

# Assessing the Awareness about Mercury Toxicity among Graduates of A Dental College in South India

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## ABSTRACT

**Introduction:** Dental amalgam is the most widely used restorative material and element mercury is an important component of it. Handling mercury causes the least threat to the patient, but could be a threat to the dentist if not practiced properly. Despite of the long history and popularity, there had been periodic concern about adverse health effects arising from the exposure of minute level of mercury released from amalgam. So the present study was done to assess the awareness about mercury toxicity among interns of dental college in South India.

**Methods:** A cross sectional questionnaire study consisting of 15 close ended questions written in English was distributed among interns during the college hours. Descriptive analysis of data was done using SPSS software.

**Results:** Results showed that all the interns were aware of potential toxicity from usage of amalgam but only 15% of interns knew the critical threshold of mercury level in dental clinics and only 60% of the interns were aware how to manage mercury spills.

**Conclusion:** Even though dental interns were aware of potential toxicity from mercury but they were not aware about the recommended guidelines while working with amalgam. So awareness needs to be created among the interns to ensure safe disposal of mercury.

**Keywords:** Assesment, Awareness, Dentistry, Graduates, Mercury Toxicity

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## INTRODUCTION

The use of amalgam as a direct restorative material dates back to A.D. 600.<sup>1</sup> Starting from the nineteenth century, dental amalgam has been widely used as a major filling material because of its low cost, durability, long term performance and ease of manipulation.<sup>2</sup> Amalgam has been described as the most complex metallurgical system to be used as a biomaterial. Element mercury is an important component of the dental amalgam. It also contains silver, tin, copper, palladium and zinc so as to improve handling characteristics and clinical performances.<sup>3</sup>

Despite of the long history of its usage and being the most commonly preferred material to restore cavities, there has been periodic concern about adverse health effects arising from the exposure of minute levels of mercury released from amalgam.<sup>4</sup> Long-term health effects of constant mercury exposure is implicated especially in causing chronic illnesses, autoimmune disorders, neuro-degenerative diseases, birth defects, and mental disorders.

Handling mercury causes the least threat to the patient, but could be a threat to the dentist if not practiced properly. Manipulation of in situ amalgam (as is done during polishing, scaling, and removal with a drill results in vaporization of mercury), results in short-term exposure of mercury vapor to dentists and other dental workers that may exceed occupational safety limits. Dentists are known to have occupational exposure to mercury vapor during these procedures.<sup>5</sup>

Since dentists work continually with amalgam they usually have higher risk and level of mercury than the general population. The higher prevalence of kidney and memory disturbances were reported among dentists as compared to general population in a study conducted in UK which showed the higher urinary mercury excretion level in dentists than in a controlled group.<sup>6</sup> To reduce the health and environmental burden of mercury, the World Dental Federation (FDI, Fédération

Dentaire Internationale) has published guidelines for mercury hygiene.<sup>7</sup> In the same way, the American Dental Association (ADA) has published (latest version in 2003) the best management practice for handling dental amalgam and mercury hygiene.<sup>8</sup> While these guidelines are important to reduce the burden of mercury exposure on the general population and environment, they are of paramount importance to dentist and more over to the interns. Moreover there is no regulatory authority especially in developing countries like India to keep a check on mercury hygiene practices.

The aim of the present study is to assess the awareness about mercury toxicity among interns in Manipal College of Dental Sciences, Manipal, Karnataka, India who are most likely to become dental professionals in future.

## MATERIALS AND METHOD

A questionnaire survey was done among graduates pursuing internship from a dental college in South India. The target sample comprised of all the interns who were using amalgam as a restorative material to restore decayed teeth. Prior to conducting the study, permission was sought from the Head of the Institution and ethical approval was obtained from Institutional Ethical Committee (IEC, 62/2015).

A structured questionnaire consisting of fifteen close-ended questions, written in English was designed to assess the awareness regarding mercury toxicity among interns and their perception of mercury hygiene practices. This questionnaire was distributed among ninety-two participants doing internship in dental college in South India. The participants were asked to complete the questionnaire during college hours and completely filled survey forms were collected back on the same day. The identity of the participants was kept confidential.

Data was entered into SPSS (Statistical Package for Social Sciences) software vs 20 and descriptive results were analyzed.

## RESULTS

The mean age of the participants were 23.25 years, ranging from 21 to 26 years and more than three-fourths were females (78.3%) (Table 1).

Table 2 showed the findings of the questionnaire. 98.9% of participants were aware of potential mercury toxicity during removal or placement of amalgam. 81.5% of the study population was aware that vapor

Variables		N	%
Age (in Years)	Mean	23.25	
	Range	21-26	
Gender	Male	20	21.7
	Female	72	78.3

**Table-1:** Demographic profile of the study population

form of mercury is the most toxic form whereas 13% selected liquid form to be more toxic and the remaining 5.4% selected solid to be more toxic. Only 19.6% of the interns selected 50 $\mu$ g/m<sup>3</sup> as the critical threshold for mercury level in dental clinic (taking an average of forty weeks), 51.1% selected 5 $\mu$ g/m<sup>3</sup> and remaining 29.3% said it to be 0.05 $\mu$ g/m<sup>3</sup>.

82.6% of the interns were aware that amalgam scraps should be disposed in a plastic container immersed in fixer solution while 15.2% thought that it should be disposed in plastic container immersed in water and a further 2.2% believed that amalgam scrap should be stored in a plastic air tight container. 90.2% of the interns said that high volume suction should be used during amalgam re-restorations to reduce mercury toxicity while the remaining 9.8% preferred the usage of saliva ejector. 67.4% of interns believed that mercury spills should be managed by picking it up using a cardboard, 23.9% thought that household cleaner containing chlorine and ammonia should be used and remaining 8.7% believed that mercury spills should be managed using a vacuum cleaner should. 51.1% the interns were aware that extracted teeth with amalgam fillings should be sprayed with disinfectant and stored in airtight containers and then sent for recycling, 28.3% selected the option of storing in formalin, 17.4% into red bag and 3.3% selected into the dustbin.

56.5% of interns knew about amalgam separators which are devices used to remove amalgam waste water from dental office waste water, while 27.2% said they are chemical disinfectant used for extracted teeth containing amalgam while 16.3% said they are chemical agent used to dislodge amalgam fillings. 91.3% believed that using pre-capsulated amalgam decreases the chances of amalgam toxicity in a dental clinic, 4.3% selected hand trituration and 4.3% selected using bulk amalgam in amalgamators.

84.8% of interns were aware that hand trituration was more likely to cause mercury toxicity as compared to 15.2% who considered that amalgamator was a more probable choice. 71.7% believed that open ventilated clinics were less likely to cause mercury toxicity as compared to 28.3% who chose AC clinics. 88% in-

Questions	Responses	N	%
1. Are you aware of potential toxicity from mercury during placement/ removal of amalgam restorations?	Yes	91	98.9
	No	1	1.1
2. Which form of mercury is more toxic to the dentist?	Vapour	75	81.5
	Solid	5	5.4
	Liquid	12	13.1
3. What is the critical threshold for mercury level in the dental clinic?	50µg/cubic m	18	19.6
	5 µg/cubic m	47	51.1
	0.05 µg /cubic m	27	29.3
4. How often do you place amalgam restorations?	less than 5 restorations in a week	69	75
	5-10 restorations in a week	21	22.8
	more than 10 in a week	2	2.2
5. How often do you perform amalgam re-restorations?	less than 5 in a week	73	79.3
	5-10 in a week	18	19.6
	more than 10 in a week	1	1.1
6. How should we dispose amalgam scraps?	In plastic air-tight containers	2	2.2
	In plastic containers immersed in water	14	15.2
	In plastic containers immersed in fixer solution	76	82.6
7. What evacuation system should be used during re-restoration?	Saliva ejector	9	9.8
	High volume suction	83	90.2
8. How should the used Fixer solution be disposed?	In the drain	12	13
	In the dustbin	18	19.6
	Given back to the seller	62	67.4
9. How should mercury spills be managed?	Pick it up using a cardboard	62	67.4
	Use a vacuum cleaner	8	8.7
	Use a broom to clean it	0	0
	Household cleaner containing chlorine and ammonia	22	23.9
10. How should extracted teeth with amalgam restoration be disposed?	Into the dustbin	3	3.3
	Into red bag	16	17.4
	Sprayed with disinfectant and stored in airtight container	47	51.1
	Store in formalin	26	28.3
11. Do you know what amalgam separators are?	Chemical agent to dislodge amalgam fillings	15	16.3
	Chemical disinfectant used for extracted teeth containing amalgam fillings	25	27.2
	Devices to remove amalgam waste water from dental office wastewater.	52	56.5
12. What decreases the chances of mercury toxicity in a dental clinic?	Using bulk amalgam in amalgamators	4	4.3
	Hand trituration	4	4.3
	Using pre-capsulated amalgam	84	91.3
13. Which method of trituration is more likely to cause mercury toxicity?	Hand trituration	78	84.8
	Amalgamator	14	15.2
14. Mercury toxicity will be less in which of the following conditions?	Air conditioned clinic	26	28.3
	Open, ventilated clinic	66	71.7
15. Is isolation with rubber dam necessary while performing amalgam restorations?	Yes	81	88
	No	11	12

**Table-2:** Study participants' responses to the questions:

terns chose that isolation is necessary while performing amalgam restorations in contrast to 12% who felt it was unnecessary.

## DISCUSSION

Even though there is plenty of literature available on mercury toxicity and disposal but still it has been seen that there is a general lack of knowledge regarding the same. If not handled properly, mercury has the potential to be hazardous for the dentist, dental personnel and patients. Dental amalgam is one of the major sources of mercury release and thus scrap amalgam management is extremely necessary during the practice. Training of all the personnel concerning the need for appropriate hygiene practices when working with amalgam and amalgam contaminated instruments and mercury waste management should be given. This study is aimed at assessing the awareness and knowledge of mercury toxicity and disposal among interns.

Our study showed that 98.9% of interns were aware of the potential toxicity from amalgam as compared to 100% in the study done by Raghavendra et al<sup>9</sup> while only 57.4% dentists believed that amalgam might constitute health hazards to dentists and dental personnel in study done in Saudi Arabia.<sup>10</sup>

Health concerns arise when mercury is in the vapour form rather than in the set amalgam form as it can be inhaled and about 80% of the mercury vapors which reaches the alveoli of the lungs are absorbed in blood.<sup>11</sup> Our study reported that 81.5% of interns were aware that vapour form of mercury is the most toxic form. Slightly less percentage (76%) of the dentists were aware of this in study by done by Raghavendra et al.<sup>9</sup> Mercury toxicity can either be in acute or chronic form. Acute inhalation of vapors causes chills, general malaise, chest tightness, dyspnea, cough, stomatitis while chronic toxicity is characterized by weakness, fatigue, anorexia, weight loss and tremors which may develop beginning with the fingers and then generalize to the entire body.<sup>12</sup> The National Institute for Occupational Safety and Health (OSHA) recommends the critical threshold for mercury vapors as 50 µg/m<sup>3</sup> for an average of 40 hours working time per week. A higher percentage (29%) of dentists were aware of this critical threshold of mercury as reported by Raghavendra et al<sup>9</sup> as compared to our study (19.6%) which showed the lack of awareness about ADA recommendations among interns.

ADA specifications recommend storing of amalgam in tightly capped jars immersed in spent fixer solution with separate jars for contact and non-contact amalgam

and with biohazard sign on it.<sup>13</sup> The results of present study showed that 82.6% of interns were aware that amalgam scraps should be stored under used fixer solution but only 34 % of dentists actually practiced it in their clinics as revealed by a study done in Pune.<sup>9</sup> Even though spent fixer was easily available in dental clinics, the lack of awareness can lead to improper storing of amalgam scraps.

According to ADA classification, a spill is considered small if less than 10 gm of mercury is present whereas a large mercury spill has more than 10 gm of mercury.<sup>13</sup> Small Mercury spill should be managed by using syringe or cardboard to pick up the droplets. Mercury should not be vacuumed with the high-volume evacuation system and use of household vacuum cleaners should be prohibited to clean up mercury spills as this can volatilize mercury. Mercury cleanup kits are also available in the market for management of small mercury spills. Large spills should be managed by environmental contractors who specialize in toxic spill cleanups. In our study only 67.4% were aware that cardboard should be used to pick up mercury spills while another study done by Sudhakar V et al., revealed a higher percentage (80%).<sup>14</sup>

Dental office waste water entering into municipal sewage water is one of the major contributors of environmental toxicity. It is measured by volume. According to Environmental Protection Agency (EPA) standards detection levels for mercury in water is 0.02µg/l.<sup>15</sup> According to ADA recommendations intra-office recapture systems i.e separators with filters or ion exchange technologies should be used to limit the levels of mercury in dental waste water. These separators remove the particles by the use of different techniques such as sedimentation, filtration, centrifugation, or ion exchange.<sup>16</sup> In our study more than half of the interns (56.5%) were aware about amalgam separators. However in a study conducted by Khandelwal et al, only 6% of dentists used them in their clinics.<sup>17</sup>

Adequate fresh air should be present in the dental clinic as this reduces the levels of toxic mercury vapors. However, nowadays most of the clinics are air conditioned so the clinicians should ensure that the filters are changed regularly. Our study showed that 71.7% interns were aware that open ventilated clinics had less chances of toxicity than air conditioned clinics. Even though our study showed that the awareness about mercury hygiene measures among interns is adequate however due to time constraints and heavy patient load, ADA recommendations are not followed during routine restorative procedures.

## CONCLUSION

Even though dental interns were aware of potential toxicity from mercury but they were not aware about the recommended guidelines while working with amalgam. So special and collective efforts should be taken to create the awareness among the interns to ensure safe disposal of mercury and follow the recommended guidelines while working with it. It can help in maintaining and restoring a healthier working environment for dentist as well as for their patients.

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