

Amalgam Management among Clinical Dental Students A Knowledge, Attitude and Practice (KAP) Survey

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Abstract

To evaluate the knowledge, attitudes, and practices (KAP) of amalgam management by International Islamic University Malaysia (IIUM) clinical dental students.

Materials and methods: Validated written questionnaires were distributed to the year 4 and year 5 students as well as lecturers who were involved in the clinical sessions. Data was collected over two months. Statistical analysis was conducted using the Statistical Package for Social Sciences (SPSS) version 16.0 software.

There were no significant differences between the students and clinical lecturers in terms of (1) knowledge of mercury exposure from amalgam and (2) amalgam handling practices ($p > .05$), except for the usage of high-volume evacuators and rubber dams as well as pouring of amalgam wastes from the filters into the sinks. As for amalgam-disposal practices, the responses were varied but there were no significant differences between the both groups as well ($p > .05$). Overall, 83% and 52.4% of the students disposed of non-contact and contact amalgam wastes respectively into closed containers which contained oil. Interestingly, 69.2% of the students claimed that they followed the prescribed amalgam management protocol at the clinic, even though 70.8% of them did not know the exact protocol and wanted to learn more about the same.

The KAP of IIUM's clinical dental students were not significantly different from those of the lecturers. However, the amalgam management protocol at the clinic should be revised to better organize the same.

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Introduction

The usage of amalgam in dentistry has been embroiled in controversy for a long time, this is due to the presence of mercury in its composition. Evidently, amalgam does not only consist of mercury (50% elemental mercury), but also silver (30%) as well as other metals such as copper, tin, and zinc (20%)¹. The dental profession is one of the largest users of mercury in its daily practice. Nevertheless, dental

amalgam has been extensively studied and reviewed, and has established a good record of safety as well as effectiveness². Dental amalgam restorations are considered to be safe, but the components of amalgam can cause local side effects or allergic reactions.

The World Dental Federation (FDI) and the World Health Organisation (WHO) stated in 1997 that small amounts of mercury released from amalgam restorations, especially during placement and removal, had no additional adverse health effects³. There is insufficient data to support any association between mercury release from dental amalgam and the various complaints that have been attributed to occupational as well as accidental elemental mercury exposures. Individuals with dental amalgam-related complaints had neither elevated urinary mercury levels nor increased prevalence of hypersensitivity to dental amalgam or mercury

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as compared with the controls⁴. The American Dental Association's (ADA's) Council of Scientific Affairs has stated that there is no solid justification for discontinuing the usage of dental amalgam at present⁵.

However, if not strictly regulated, the manipulation of amalgam and management of its waste at the dental office can contribute to the risk of occupational exposure as well as environmental pollution. Potential health hazards of mercury exposure to oral health personnel arise if the working conditions are not properly managed. The execution of proper mercury hygiene protocols along with the monitoring of mercury vapours at the dental clinics will significantly reduce mercury exposure⁶.

Moreover, mercury that is used in dentistry may contaminate the environment via the disposal of waste products from dental clinics. Nevertheless, according to the Environmental Protection Agency (EPA), less than one percent of the mercury which is released into the environment comes from amalgam⁷. Evidently, equipment is available for collecting the wastes generated during dental amalgam placement and removal. Appropriate collection and recycling technologies are also in place to reduce environmental pollution by mercury⁸. Thus, mercury exposure risk might not be an issue if a standard amalgam-handling protocol is complied with.

There are numerous recommendations for the methods of management of amalgam. For example, the ADA has established guidelines for the protection of dental healthcare workers and the environment. They have also devised the best management practices for the management of amalgam⁹. Hence, these recommendations should be put into practice to minimise the harms to the dental health workers and other individuals. The barrier technique – in which face masks, face shields, gloves, and protective eyewear are worn by the operators – is one of the most commonly-practised amalgam-handling methods. However, a standard mask is unable to filter mercury vapour or amalgam particles whose diameters are less than 10 µm, and that filtration protection varies in different masks¹⁰. Still, as a bare minimum, preventive measures should be taken to reduce the exposure to amalgam.

Although mercury in the form of dental amalgam is very stable, the latter should not be disposed into general waste, infectious waste,

pharmaceutical waste, and sharps bags or containers. Nor should it be flushed down the drains. These precautions are important in view of the fact that some communities incinerate municipal garbage, medical wastes, and sludge from wastewater treatment plants. If amalgam wastes end up in one of these incinerated waste streams, mercury can be released to the environment owing to the extremely high temperatures during incineration. Accordingly, more and more local communities are endorsing restrictions on the incineration of mercury-containing wastes. Amalgam wastes, if kept separate from other types of wastes, can actually be safely recycled. Evidently, recycling is one of the best practices for dental clinic amalgam waste management¹¹.

Thus, the aim of this study was to evaluate the KAP of IIUM's clinical dental students in terms of amalgam management at the IIUM Dental Polyclinic. The clinical lecturers were the controls.

Materials and methods

1. Selection of samples

All 92 Year 4 and Year 5 students (40 students year 4 and 52 students year 5, in addition to 9 clinical lecturers who were supervising the said students, were recruited for this study.

The inclusion criteria were as follows:

- Students and lecturers of IIUM's Dental Polyclinic
- Clinical experience of more than one-and-a-half years
- Involvement in restorative procedures

Meanwhile, the exclusion criteria were as follows:

- Clinical experience of less than one-and-a-half years
- Lecturers who were not involved in restorative procedures
- Co-supervisor of this research

2. Questionnaires

Every participant was given a questionnaire that was divided into six parts, each of which comprised five close-ended questions and one open-ended question. The objective of the questionnaire was to measure the KAP of amalgam management at the clinic.

3. Data analysis

All data were analysed using the Statistical Package for Social Sciences (SPSS)

version 16.0 software. In the case of open-ended questions (qualitative data), similar responses to each question were categorised into the same group via coding prior to analysis.

Results

Variables	Year 4 & 5 students (n=65) Median (IQR)	Lecturer (n=9) Median (IQR)	Z statistic	p-value
Wear gloves	5(0)	5(0)	-.372	.710
Wear mask	5(0)	5(0)	-.372	.710
Change gown after each patient	3(1)	3(0)	-1.130	.258
Use high vacuum evacuator during finishing or removing amalgam	2(1)	4(1)	-3.630	.000
Use eye protection for your patient and yourself	5(0)	5(0)	-1.920	.055
Use rubber dam	2(1)	3(2)	-3.566	.000
Recap the capsule after use	4(3)	4(2)	-.420	.674
Store the amalgam scrap/waste in a closed container	5(1)	5(0)	-.178	.859
Pour the amalgam waste from the filter into the sink	5(2)	5(2)	-2.345	.019

Table 1. Amalgam-handling practices of students and clinical lecturers.

Note: $p < .05$ in Mann-Whitney U-test

The questionnaire was administered on 40 fourth-year students, 52 fifth-year students, and nine clinical lecturers from the Conservative

Department, Paediatric Dentistry Department, as well as General Dental Practice Department. Of the questionnaires that were returned, only 65 (9 clinical lecturers, 23 fourth-year students, and 42 fifth-year students) were managed to be answered.

There were 14 questions in the knowledge section. No statistically-significant differences were observed between the lecturers and students in terms of knowledge of mercury exposure from amalgam. ($p = .519$). Both groups (students and lecturers) managed to answer the questions well; the average score was 78%.

There were no statistically-significant differences between the lecturers and students in terms of practices like wearing of masks and gloves, changing of gowns, usage of eye protection, recapping of amalgam capsules, as well as storage of amalgam scraps in closed containers (Table 1). However, the converse was true for (1) the usage of high vacuum evacuators (HVEs) during finishing or removal of amalgam, (2) the usage of rubber dams, as well as (3) pouring of amalgam wastes from filters into the sinks ($p = .000$, $.000$, and $.019$ respectively). Evidently, the students rarely used HVEs and rubber dams (median = 2; interquartile range or IQR = 1), unlike the lecturers (median = 4 and 4 respectively; IQR = 2 and 1 respectively). The practice of pouring of amalgam wastes from filters into sinks had a median and IQR of 5 and 1 respectively for both groups. This suggested that the students and lecturers executed the abovementioned action even though the results were statistically significant.

Variables	Year 4 & 5 students (n=65) Median (IQR)	Lecturers (n=9) Median (IQR)	Z statistic	p-value
Non-contact amalgam scrap/ waste (i.e. no contact with patient)	4(0)	4(0)	-.602	.547
Contact amalgam waste (contact with patient)	4(3)	1(3)	-.085	.932
Extracted teeth with amalgam restoration/filling	1(1)	1(1)	-2.053	.040
Amalgam waste from the filter of the spitting bowl	4(3)	1(3)	-.778	.437
Amalgam waste from the filter of dental chair	4(3)	1(3)	-.229	.819

Table 2. Amalgam-disposal practices of students and lecturers.

Note: $p < .05$ in Mann-Whitney U-test

The responses for amalgam-disposal were varied. However, there were no significant differences between the students and lecturers except for the disposal of extracted amalgam-containing teeth ($p = .04$). For this item, the medians and IQRs of both groups were interestingly the same (all 1) (Table 2). Some 83.1% and 52.3% of the students disposed of the non-contact and contact amalgam wastes respectively into closed containers which contained water and oil; this was the best management practice according to the ADA guidelines. On the other hand, 66.2%, 49.2%, and 46.2% of the students disposed of the (1) extracted amalgam-containing teeth, (2) amalgam wastes from spittoons, and (3) amalgam wastes from the filters of the dental chairs respectively into the clinical waste bins. The students' responses for the rest of the items on amalgam wastes were variable, whereby the second highest percentage were sharp bin for extracted teeth containing amalgam and general waste bin for amalgam waste from spittoon and filter of dental chair (Table 2). The abovementioned variation could have reflected the students' ignorance of the methods for the disposal of these amalgam wastes, or the absence of standard guidelines for the same.

In terms of amalgam use and management, did not comprehend these ideas, there were no significant differences between the students and lecturers except for the idea that amalgam was hazardous to the patients. Most of the students were neutral with regards to the idea of prohibiting amalgam and the hazards of amalgam towards the patients as well as elementary staff. It could be inferred that the students, or that they just want to be safe or passable for that. However, 92.3% of the students agreed that formal lectures on active elements should be included in the dental curriculum, while 87.7% concurred with the execution of periodic mercury checks at every dental clinic. Additionally, 69.2% of the students claimed that they followed the prescribed amalgam-management protocol of the IUUM Dental Clinic (27.7% were neutral and 3.1% denied). Some 60% of the students were neutral over the dental clinic's compliance with the ADA's recommendation in terms of amalgam management.

As for the open-ended questions, 50 respondents (7 lecturers and 43 students)

preferred composite materials over amalgam for restorations. Aesthetics was the most popular reason (38 respondents) for the same; only 9 respondents gave the reasons of safety and absence of mercury vapour. On the other hand, the 16 respondents preferred to utilise amalgam owing to its ease of use, low moisture content, and durability.

Only 72 of 74 respondents gave their opinions on the usage of amalgam in clinical practice shows that. From there, 27 felt that amalgam was still relevant and feasible in clinical practice, while 6 opined that amalgam was not practical and that its usage should be prohibited.

Regarding the aspects of amalgam and mercury of which the respondents wanted to learn more, only 61 of 74 participants provided their responses. From there, 28 wanted to know more about the management and protocol of amalgam usage, while 15 of them needed further information of the disposal of amalgam. Hence, 43 of the 61 respondents were keen to learn more about the management of amalgam.

Knowledge about amalgam separator	Lecturers n=9 n(%) std. residual	Students n=65 n(%) std. residual	Likelihood ratio	p-value
Yes	2 (66.7) 2.7	1 (33.3) -1.0	5.241	.037
No	7 (9.9) -.6	64 (90.1) .2		

Table 3. Knowledge of amalgam separator and its uses.

Note: $p < .05$ in chi-square test

Knowledge about prescribed protocol of amalgam	LECTURER n=9 n (%) std. residual	STUDENT n=65 n (%) std. residual	Likelihood ratio	p-value
NO	2 (4.2) -1.6	46 (95.8) .6	7.864	.023
YES	7 (26.9) 2.2	19 (73.1) -.8		

Table 4. Knowledge of the prescribed amalgam-management protocol.

Note: $p < .05$ in chi-square test

According to Table 3, there was a significant difference between the students and lecturers pertaining to the knowledge of amalgam separators ($p = .037$); 90.1% of students did not have knowledge of the same.

The lecturers' knowledge of the prescribed amalgam-management protocol was significantly better than that of the students ($p = .023$) (Table 4). Ironically, 69.2% of the students claimed that they followed the said protocol at the clinic even though 70.8% of them did not know the exact protocol. The remaining 19 students reported that they knew the protocol. Some 11 of these 19 students claimed that they have had formal lectures on the same. Meanwhile, three of them underwent formal courses, four obtained the information from the internet, and six learned this from the nurses.

The following were the opinions and comments of the lecturers with regards to the amalgam-management practices of the students at IIUM's Dental Clinic:

1. Not sure.
2. Students need to have excess amalgam storage (containers) at each cubicle.
3. I am sure they can use the container with water and oil, but not sure on the use of HVE.
4. Students do not know the protocol; have to be more cautious.
5. Good; all (students) following (the) protocol
6. Recommend to monitor the management of amalgam.
7. Prepare closed bottles for amalgam waste at both cubicles and main places.

Discussion

The results of this study will be discussed according to three categories: knowledge, practices, and attitudes.

In terms of knowledge of mercury exposure from amalgam, there were no statistically-significant differences between the lecturers and students ($p = 0.519$). Both groups managed to answer the questions well, which proved that they had good understanding of mercury in amalgam. This concurred with the statement by the California Dental Association (CDA) that dental amalgam has been a subject of attention for the regulators in view of elementary mercury being its major component, and that certain forms of mercury were toxic¹².

As for practices, there were significant differences between both groups. Apart from not using HVEs ($p = 0.000$) and rubber dams ($p = 0.000$), most students poured the amalgam

wastes from the filters into the sinks ($p = 0.019$) as well. It was concluded that dental procedures like amalgam-mixing, condensing, and polishing release high volumes of mercury vapour which enter the human body through inhalation¹³. On another note, most students did not know where to discard the amalgam-filled extracted teeth. This could have been due to the students' ignorance of the proper protocol, or the absence of standard guidelines for them. Concurrently, the lecturers have had formal courses on amalgam disposal, thus contributing to the aforementioned significant difference ($p = 0.040$). According to the IMERC (mercury), the best management practices (BMPs) for amalgam wastes should be introduced. Also, these BMPs should include the installation of amalgam separators, proper management of amalgam-containing solid wastes, and recycling of amalgam¹⁴.

With respect to the attitudes, most students were neutral over the usage of amalgam since it was one of the best restorative materials. Bharti et al. (2010) stated that amalgam restorations lasted longer than previously thought, and that it could perform satisfactorily for more than 12 years^{15,16}. Given a choice between amalgam and a composite, the latter would be preferable as it provided better aesthetics apart from being safe (i.e. free from mercury vapour). More than half of the students needed a proper and formal amalgam-management course which covered the properties, placement, and disposal of amalgam. This comes in line with that dentists should follow the rules and regulations of amalgam management in order to reduce the society's exposure to the toxic effects of mercury¹⁷.

Conclusions

All dental schools in Malaysia should provide formal courses on amalgam management protocols to their students, staff, and lecturers. Additionally, standard guideline on the same should be devised to minimise confusions and variations in the practice. Such guidelines should be made clear to the students and staff via written notices or briefings. Labelled closed containers need to be provided at each cubicle to facilitate the proper separation of amalgam wastes and prevent the students from inappropriately disposing amalgam. Finally, the implementation of the best management

practices in all dental communities will ensure that the mercury in amalgam will not pose health and environmental risks.

Declaration of Interest

The authors report no conflict of interest.

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