

Has the implementation of the Minamata convention had an impact on the practice of operative dentistry in Jordan?

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Abstract

Objective: To assess Jordanian dentists' current perception and attitudes towards amalgam and composite restorations four years after the Minamata treaty was endorsed and suggest decision making factors that may influence the type of restoration requested by patients.

Methods: The cross-sectional study was conducted through structured questionnaires distributed to dentists in Amman, Jordan from June 2017 to February 2018.

Results: Of the 1686 dentists who were contacted 758 dentists (response rate 45%) responded to the questionnaire either by email or via field visits. Jordanian dentists used more composite restorations than amalgam. Recurrent caries followed by fracture of the restoration were the main reasons for replacement of both fillings by dentists. However, dentists suggested that the main reason patients requested replacement of amalgam was for 'staining'. In addition, a large proportion of the dentists had experienced patients who had asked either for replacement of amalgam (77%) or refused an amalgam filling (99%) for aesthetic reasons. In the opinion of the dentists, only 20% patients requested replacement of amalgam because of the mercury content.

Conclusion: The findings of this survey suggest that a 'phase-down' of dental amalgam is being implemented in Jordan's dental clinics but it is not associated with commitment to the Minamata Convention, rather to current dental practice trends and patients' aesthetic demands.

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Introduction

The Minamata Convention on Mercury is a global treaty designed to protect human health and the environment from the adverse effects of mercury.¹ The convention identified dental amalgam as one of the mercury products whose use should be 'phased down' by countries that signed the agreement in 2013.² The decision to 'phase down' rather than 'phase out' dental amalgam was extensively debated.³ Several factors including a paradigm shift toward preventive, non-operative and interceptive treatment strategies,^{4,5} the establishment of minimally invasive approaches and ultra-conservative intervention modalities⁶ have encouraged the gradual transition from amalgam as a material of choice for operative dentistry towards mercury-free restorations such as composite resin and glass ionomers.^{4,7} Indeed, it is more convenient and advantageous for both dentists and patients to preserve healthy tooth structure with non-invasive restoration rather than sacrifice healthy tissues for macro retentive restorations.^{6,8,9} In addition, the increased patient awareness and demand for composite resin white restorations for tooth-coloured aesthetic restorations,^{4,9} and the increasing concern about environmental and health implications of mercury from dental amalgam^{4,10} has influenced recent operative dentistry practices and created a shift away from amalgam towards composite resin.¹¹

However, in spite of all the factors favouring composite resin restorations,^{4,11} ultraconservative resin infiltration

techniques⁸ and resin modified glass ionomer approaches,^{7,12} amalgam is still widely used in some countries, mainly because of the demanding adhesive techniques and shortcomings inherent with composites.¹³ Limitations of composites include issues related to longevity, technique sensitivity, time-consuming procedures, reduced wear resistance, lack of compressive strength, low fracture resistance, marginal staining, increased microleakage and secondary caries.^{4,13,14}

The World Health Organization (WHO) in 2009 reported that in Jordan, amalgam was used in >90% of restorations made in government clinics, 70–80% of restorations made in dental schools and 60–70% made in dental practices.¹⁴ Jordan was one of the countries that signed the Minamata agreement in 2013. Therefore, the objective of this present study was to assess Jordanian dentists' current perception and attitudes towards both amalgam and composite restorations four years after the treaty had been signed. To this end, a sample of dentists were asked for their opinions on a number of patient related factors that may have influenced their decision-making.

Methods

The cross-sectional study took place from June 2017 to February 2018 in Amman, Jordan. A structured questionnaire was distributed either by e-mail or by-hand to dentists registered with the Jordanian Dental Association (JDA) in different dental sectors (i.e., private clinics/Ministry of

Health/University of Jordan/Royal Medical Services). General practitioners, specialists in operative dentistry, endodontics and fixed prosthodontics were eligible for the study providing that they had at least five years' experience as a working practitioner.

The questionnaire was developed by one of the investigators [AAA] and using a sample of 10 dentists (operative dentistry specialists), the same investigator conducted a pilot test and revised the survey. (Appendix1). In addition to details regarding socio-demographic and professional characteristics, dentists were asked to complete questions on use of amalgam or composite restorations in different types of cavities and provide suggestions on patients' opinions of the different types of restoration. The protocol was reviewed and approved by the Faculty of Dentistry Research and Ethics Committee (FDREC) at the University of Jordan, Amman, Jordan.

Data were collected by three investigators [AAA, KMA, TZA] and analysed by two investigators [AAA, FAS] using the Statistical Package for Social Sciences (SPSS) for Windows release 16.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were calculated for dentist, patient and restoration variables. The χ^2 test was used to examine differences in distribution between groups. A *P*-value <0.05 was considered to indicate statistical significance.

Results

From the 1686 dentists registered with the JDA who were contacted, 758 dentists (i.e., response rate 45%) responded to the questionnaire either by email (156) or via field visits to their working place where data were collected by hand (602).

Demographic characteristics of the dentists involved in the analyses are shown in Table 1. Although the inclusion criteria specified that dentists must have at least

Table 1. Demographic characteristics of the study population (*n*=758).

| Characteristic | Dentists <i>n</i> (%) |
|---|--------------------------|
| Sex | |
| Male | 458 (60) |
| Female | 300 (40) |
| Country of graduation | |
| Jordan | 392 (52) |
| Arab and Asian countries | 247 (33) |
| Eastern Europe | 66 (9) |
| Western Europe | 53 (7) |
| Years of experience | |
| 1–5 | 163 (22) |
| 6–10 | 207 (27) |
| 11–15 | 176 (23) |
| >15 | 212 (28) |
| Service sector | |
| Public | 154 (20) |
| Private | 604 (80) |
| Type of practice | |
| General practitioner | 449 (59) |
| Specialist | 309 (41) |
| Average age of amalgam restoration replaced, years | |
| ≤5 | 93 (12) |
| 6–10 | 357 (47) |
| 11–15 | 290 (38) |
| >15 | 18 (2) |
| Average age of composite restoration replaced, years | |
| ≤5 | 608 (80) |
| 6–10 | 115 (15) |
| >10 | 35 (5) |

five years working experience, analysis showed that 163 dentists from our sample were recent graduates. After some debate, the decision was made to include their data because they constituted a large proportion (22%) of the entire sample and provided a youthful perspective on current dental practices.

There were more male than female dentists (60%:40%), most (80%) were working in the private sector and 59% were in general practice. Approximately 50% dentists had trained in Jordan. Although only 12%

Table 2. Responses to questions (Q) related to use of dental amalgam or composite ($n=758$).

| Over the past 5 years | Amalgam <i>n</i> (%) | Composite <i>n</i> (%) |
|---|-------------------------|---------------------------|
| Q1. Which material have you used most for posterior class I restorations? | 48 (6) | 710 (94) |
| Q1. Which material have you used most for posterior class 2 restorations? | 220 (29) | 538 (71) |
| Q1. Which material have you used most for posterior class 5 restorations? | 13 (2) | 745 (98) |
| Q2. Which material have you replaced most? | 454 (60) | 304 (40) |
| Q3. Which material have you repaired most? | 234 (31) | 524 (69) |

of amalgam restorations were replaced by a dentist within five years after insertion, 80% of composite restorations were replaced within the same period (Table 1).

When asked which material they used most in the past five years, composite was used more than amalgam for class I (94%:6%) class II (71%:29%) and class V cavities (98%:2%) (Table 2). Dentists reported that in the past five years of practice they had replaced amalgam more frequently than composite restorations (60%:40%) but had repaired composite more frequently than amalgam restorations (69%:31%) (Table 2). The use of amalgam was significantly higher in cases of class II restorations by dentists working in the public sector (43%) compared with dentists in the private sector (26%) (data not shown) ($P \leq 0.05$).

Recurrent caries followed by fracture of the restoration were the main reasons for replacement of both amalgam and composite fillings by the dentists (Table 3). Although dentists suggested that these were also the main reasons why patients requested replacement of composites, the dentists thought that 'staining' and 'loss of anatomy' were the main reasons patients requested replacement of amalgam. In addition, recurrent caries were reported more frequently with composite restorations (63%) compared with amalgam restorations (36%) ($P \leq 0.05$) (Table 3).

Approximately, one quarter of dentists (26%) reported that their patients knew

about the advantages/disadvantages of amalgam and composite restorations. In addition, 77% dentists had experienced a patient who asked to replace amalgam for aesthetic reasons, 1% because of the mercury content and 23% for both aesthetic and mercury content reasons. Furthermore, 99% dentists had experienced a patient who refused to have an amalgam filling for aesthetic reasons and 20% because of the mercury content. The vast majority of dentists (93%) were of the opinion that patients prefer composite over amalgam restorations but 20% of dentists had experienced a patient who preferred amalgam over composite because of its cheaper price.

Discussion

The results of our study suggest that in Jordan over the past five years there has been a fundamental shift away from amalgam towards composite resin dental restoration for class I, II and V posterior cavities. In the opinion of our sample of dentists, while patients had requested replacement of amalgam for aesthetic reasons rather than health reasons, dentists had replaced amalgam because of recurrent caries and fractures. Indeed, according to the dentists, recurrent caries followed by fracture of the restoration were the main reasons for replacement of both amalgam and composite fillings. Similar results have been reported by other researchers.¹⁵⁻²¹

Table 3. Dentists' opinions on reasons for replacement of amalgam or composite restorations (n=758).

| Question | n (%) |
|--|----------|
| Q4. Reasons for dentist replacement of amalgam restorations | |
| recurrent caries | 269 (36) |
| fracture of restoration | 203 (27) |
| fracture of tooth | 79 (10) |
| staining of restoration | 13 (2) |
| loss of anatomy | 84 (11) |
| aesthetic reasons | 35 (5) |
| patient's request | 75 (10) |
| Q5. Reasons for dentist replacement of composite restorations | |
| recurrent caries | 476 (63) |
| fracture of restoration | 128 (17) |
| fracture of tooth | 57 (8) |
| staining of restoration | 35 (5) |
| loss of anatomy | 13 (2) |
| aesthetic reasons | 0 |
| patient's request | 49 (7) |
| Q6. Reasons patients request for replacement of amalgam restorations | |
| recurrent caries | 71 (9) |
| fracture of restoration | 48 (6) |
| fracture of tooth | 132 (17) |
| staining of restoration | 229 (30) |
| loss of anatomy | 190 (25) |
| aesthetic reasons | 66 (9) |
| other | 22 (3) |
| Q7. Reasons patients request for replacement of composite restorations | |
| recurrent caries | 203 (27) |
| fracture of restoration | 106 (14) |
| fracture of tooth | 97 (13) |
| staining of restoration | 101 (13) |
| loss of anatomy | 110 (15) |
| aesthetic reasons | 57 (8) |
| other | 84 (11) |
| Q8. Do patients ask to replace amalgam because of aesthetic or mercury content or both reasons? | |
| aesthetic | 581 (77) |
| mercury content | 4 (1) |
| both reasons | 173 (23) |
| Q9. Do your patients refuse to have amalgam restorations because of aesthetics? | |
| yes | 749 (99) |
| Q10. Do your patients refuse to have amalgam restorations because of mercury toxicity? | |
| yes | 150 (20) |
| Q11. Do your patients know about the advantages/disadvantages of amalgam and composite restorations? | |
| yes | 198 (26) |
| Q12. Do your patients prefer composite over amalgam restorations? | |
| yes | 701 (93) |
| Q13. Do your patients prefer amalgam over composite because of its cheaper price? | |
| yes | 154 (20) |

Interestingly, the dentists in our current sample reported that more composite restorations than amalgam restorations had been replaced within the past five years. This finding is consistent with a previous study that reported twice as many composite restorations required further intervention over a five-year period compared with amalgam restorations.²²

With the exception of the service sector where more amalgams were used for class II restorations by public sector dentists, none of the dentists' demographic characteristics (i.e., sex, country of graduation, years of experience, type of practice) appeared to affect the type of dental material he/she used. These results are consistent with other studies, which also found that apart from the type of the service sector (public/private), demographic variables did not have an effect on choice of restorative material for fillings.^{4,23-25}

Although approximately a quarter of the dentists reported that their patients knew about advantages/disadvantages of both types of restorations, they recorded that only a small percentage of patients ($\leq 20\%$) refused to have amalgam because of the mercury content. Almost all dentists (99%) reported that most patients refused to have an amalgam restoration because of aesthetic reasons. These findings are not surprising and concur with several reports that have found that patients' main concerns about treatment relate to the cosmetic look of the fillings.^{24,26-29} Despite issues of longevity or durability of the restoration,^{4,10,24} a pearly white smile is the prevalent trend nowadays.^{27,28} Nevertheless,, our data showed that dentists believed there is a small percentage of patients (20%) who preferred amalgam over composite because of its cheaper price. These findings are consistent with data from other reports that found financial consideration was an influencing factor in choosing

the type of material for the restoration of posterior teeth.^{2,27}

To the best of our knowledge, this is the first study to assess the influencing factors associated with the type of material used for restorative dentistry in Jordan since the Minamata agreement was signed in 2013. However, the study had several limitations. Firstly, although the inclusion criteria specified that dentists must have five years working experience, 22% of our sample were recent graduates and had practiced dentistry for < 5 years. After some debate, the decision was made to include their data because of their large sample size and their youthful perspective on current dental practices. Secondly, dentists were asked to provide their patients' opinions on the different types of restorative fillings. Therefore, these data may be subject to response bias. Thirdly, the sampling methodology was not robust; participants were recruited either by email or clinic visit which may have led to selection bias. Finally, only dentists in Amman were involved in the study and so the findings may not truly reflect the attitudes of all Jordanian dentists.

Although composites have not evolved to the point of totally replacing amalgam, they have become a workable substitute for amalgam in many clinical situations.^{25,30-32} We can conclude from this study that 'phase-down' of dental amalgam is occurring in Amman, Jordan. However, it appears that the 'phase-down' is not directly associated with the commitment to the 2013 Minamata Convention and is independent of dental and/or public awareness regarding mercury-related health or environmental hazards.^{2,4} We are of the opinion that amalgam displacement and dethroning in Amman, and probably the rest of the world, is more related to current dental trends and patients' aesthetic demands.

Declaration of conflicting interests

The authors declare that there are no conflicts of interest.

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Appendix I. Questionnaire

1. Have you used more amalgam or more composite restorations in class I, class II, and class V posterior cavities?
2. Have you replaced more amalgam or more composite restorations in the past five years?
3. Have you repaired more amalgam or more composite restorations in the past five years?
4. What is the most common reason for replacing amalgam restorations?
5. What is the most common reason for replacing composite restorations?
6. What is the patient's most common reason for replacing amalgam restorations?
7. What is the patients' most common reason for replacing composite restorations?
8. In your opinion, do patients ask for amalgam restoration replacement for

- aesthetic reasons, because of mercury hazards in amalgam, or both?
9. In your opinion, do patients refuse dental amalgam restorations because of aesthetic reasons?
 10. In your opinion, do patients refuse dental amalgam restorations because of mercury hazard reasons?
 11. Are your patients aware of the advantages/disadvantages of both amalgam and composite restorations?
 12. Do your patients ask for and accept more composite restorations than amalgam restorations?
 13. Do you think the financial element plays a role in your patients' selection regarding type of restoration (i.e., amalgam is cheaper than composite)?