ORIGINAL ARTICLE

An Evaluation of Dental Amalgam Waste Disposal Practices in Dental Teaching Hospitals and Private Clinics of Islamabad

Kefi Iqbal[1], Shehriar Husain[1], Usman Mahmood[2] and Rizwan Ullah[1]

ABSTRACT

Objective: To highlight the extent of implementation and current waste dental amalgam disposal procedures in dental teaching hospitals and private practices in Islamabad and Punjab province, Pakistan; according to International Standard Organizations' (ISO) guidelines.
Methodology: A customized questionnaire was dispatched to various teaching hospitals, dental outpatient departments (OPDs), and private clinics located in urban and semi-urban parts of Islamabad, Lahore, and Rawalpindi districts. The overall response rate was close to 90%. Out of 300 forms dispatched to the above mentioned urban and semi-urban zones; a total of 261 respondents returned the filled questionnaires.
Results: Majority of respondents in both the hospitals and private clinics resorted to non-ISO compliant methods of disposing off waste dental amalgam such as the waste bin—teaching hospitals (75%) and private practice (61%)). Handmixing technique or manual trituration was reported around 37.5% as compared to ideal method of encapsulated amalgam manipulation (58.6%).
Conclusion: In order to improve handling of waste amalgam in the dental practice, effective implementation of Best Management Guidelines at the regional and national level, such as regular continuous dental educational activities at dental learning centers for staff and practitioners, would help towards creating a better understanding amongst all stakeholders with respect to the biological and environmental impact of generating unregulated dental amalgam by products.

Key words: dental amalgam, dental waste, mercury

How to cite this article: Iqbal K, Husain S, Mahmood U, Rizwan Ullah. An evaluation of dental amalgam waste disposal practices in dental teaching hospitals and private clinics of Islamabad. Ann Jinnah Sindh Med Uni 2018; 4 (2): 75-79

صوبہ پنجاب اور اسلام آباد میں دانتوں کی تدریس کے ہسپتالوں اور نجی کلینکس میں دانتوں کے تیاری کے ملغوبے کو تلف کرنے کے عمل کی تشخیص

خلاصہ:

مقصد: (ISO) آئی ایس او کی مروجہ ہدایات کے مطابق صوبہ پنجاب اور اسلام آباد میں دانتوں کی تدریس کے ہسپتالوں اور نجی کلینکس میں دانتوں کی تیاری کے ملغوبے کو تلف کرنے کے مروجہ طریقہ کار پر روشنی ڈالنے کے لیے تحقیق کی گئی

طریقہ کار: ایک سوالنامہ راولپنڈی، اسلام آباد، لاہور کے شہری اور نیم شہری علاقوں میں واقع مختلف تدریسی ہسپتالوں اور او پی ڈیز میں بھیجا گیا۔ جس کا مجموعی طور پر نوے فیصد افراد نے جواب دیا۔ کل تین سو سوالناموں میں سے 261 سوالناموں کے جوابات موصول ہوئے۔

نتائج: جواب دہندگان کی بڑی تعداد نے دانتوں کی تیاری کے ملغوبے کو تلف کرنے کے ISO کے مخالف طریقہ کار کو اپنایا ہوا ہے۔ تدریسی ہسپتالوں میں 75 فیصد اور نجی کلینکس میں 61 فیصد نے کوڑے دان کا استعمال رپورٹ کیا۔ ہاتھوں سے ملانے کا طریقہ کار 37.5 فیصد لوگ استعمال کرتے ہیں جبکہ مسلک ملغوبے کو ملائے جانے کے مثالی طریقے 58.6 فیصد میں عام تھے۔

حاصل مطالعہ: دانتوں کے معالجوں میں ملغوبے کے فضلے کی بہتر انداز میں تلفی کے لیے صوبائی اور قومی سطح پر اداروں کی ہدایات پر موثر عمل درآمد ضروری ہے جیسے کہ دانتوں کے ہسپتالوں میں ملازمین اور معالجین کے لیے دانتوں کی حفاظت کے حوالے سے تربیتی سرگرمیاں منعقد کی جائیں ایسا کرنے سے حیاتیاتی اور ماحولیاتی اثرات کے حوالے سے دانتوں کے ملغوبے کی تلفی کے بارے میں ان کی معلومات میں بہتری آئے گی۔

1. Dental Biomaterial Department, SIOHS, Jinnah Sindh Medical University, Karachi, Pakistan
2. Lahore Medical and Dental College, Lahore, Pakistan

Correspondence: Dr. Shehriar Husain, Senior Lecturer, Dental Biomaterial Department, SIOHS, Jinnah Sindh Medical University, Karachi, Pakistan

Email: shehriar.husain@jsmu.edu.pk

INTRODUCTION

The use of Mercury (Hg) as a constituent in the formulation of dental amalgam goes back to at least more than 17 decades[1-3]. Suffice it to say dental amalgam is one of the oldest restorative materials in the armoury of dentistry still in use today[4]. The powder component of dental amalgam is primarily composed

of silver, tin, zinc and copper, which is mixed with approximately 50% mercury to form a plastic mass that lends itself to easy manipulation and subsequent placement inside a prepared cavity, where, upon setting, it will exhibit sufficient hardness and durability in the oral environment suited for long term performance. The United States based Environmental Protection Agency (EPA) has placed restrictions on the mercury levels considered as safe to 10µg/day[5]. Dental amalgam is the most utilized direct restorative material in dentistry. This is due to its ease of placement (in and around the confines of the prepared tooth structure), good wear resistance, excellent values of compressive strength, low creep, minimal dimensional changes over a long time period and cost effectiveness. Moreover, a good marginal seal at the tooth-restoration interface courtesy corrosion product build up[3,6] coupled with placement in wet fields (for the less experienced clinician and difficult to isolate restorative zones), places dental amalgam in a unique position in the direct restorative material inventory of the clinic. However, the issue of biocompatibility of dental amalgam and minimum tolerable level of toxicity has always been a pressing and hotly debated matter in medical and public fora alike[7].

The testing of amalgam separators is done according to the guidelines put forth by the International Standards Organization (ISO). They are specified in ISO standard and number 11143—which effectively assesses the efficiency of removal in terms of the reduction in the number of amalgam particles entering the sewer system[8,9]. Until such time that the complete phase down of dental amalgam in everyday dental use worldwide is complete, it is paramount that disposal protocols of waste amalgam generated at chairside are handled with extreme caution in line with international protocols, so as to minimize the adverse effects of mercury exposure and subsequently limit the exposure of dental personnel and patients[10]. A significant burden of waste dental amalgam becomes part of oceanic environmental niches and subsequently assimilated by marine life (inevitably ingested by humans). This also creates the premise of a lead up towards the contamination of public drinking water.

International guidelines such as the Hazardous Waste Directive (91/689/EEC) developed in the European Union, specifies that any amalgam that is generated in the dental out-patient department (OPD) or in the hospital setting, must be disposedof in such a manner that there is no foreseeable danger to human health and/or the environment. Without proper ISO procedures to control amalgam waste at chairside, it is inevitable that multiple-sized particles of amalgam (during the filling process) would end up discarded and enter the standard waste stream via the chairside suction device. The process whereby wastes of multiple origins make their entry into water systems is recognized as 'waste water discharge'. This is subject to a number of controls and regulations in many western countries. Since healthcare workers in particular and organizations in general are actively involved in a number of activities pertaining to generating dental/medical waste such as dental amalgam, it is only logical to strictly regulate the manipulation of amalgam and its waste products at the national level. In spite of rampant and un-regulated use of dental amalgam in many regions around the world owing to its high durability, low technique sensitivity during placement and cost effectiveness when compared to aesthetic resin based direct restorative materials; global levels of awareness and subsequent realization of the impact of mercury discharge from dental surgeries and hospitals on the environment are on the rise. There are a few high income nations that have sought to impose a ban on dental amalgam use due to the relatively easier availability, accessibility, on par (and in some cases superior) clinical performance coupled with a higher biological and environmental safety index of tooth coloured restorative dental materials[11].

Dental amalgam remains, to date, the mainstay direct restorative material in the operative dentistry armamentarium for the better part of 150 years in many countries. This has especially been the case in countries like Pakistan and the United Kingdom (UK). In the case of the UK; large segments of dental care that fall within the domain of the National Health Service (NHS) have been traditionally associated with the use of dental amalgam[12]— this trend can be allocated for the economic and performance reasons stated above. The large number of aged dentate patients that were at the receiving end of multiple and extensive amalgam restorations are now living with unaesthetic and mechanically retained dental amalgam fillings with considerably weakened surrounding tooth structure. Moreover, the demand for complete replacement of sound dental amalgam restorations with resin based alternatives for purely aesthetic reasons is predicted to rise in the backdrop of increased life spans.

This study aims to catalogue and evaluate the various dental amalgam disposal methods utilized by dental hospitals and private clinics across the territories of Islamabad and Punjab province, Pakistan.

METHODOLOGY

A questionnaire with items documenting the waste management practices of dental amalgam was dispatched to dental hospitals and private clinics in Islamabad, Rawalpindi, Lahore, Multan, Sheikhapura, Sharaqpur, and Sialkot districts. The respondents were

dentists and house officers working at teaching hospitals and private clinics in the districts mentioned. They were asked to fill questionnaires detailing daily practices pertaining to waste disposal, amalgam dispensation and the number of restorations performed and removed by the dental practitioners. In addition to these, the questionnaire was supplemented with queries about the nature of dental practice and the locality in which the private practice and/or hospital was located.

The over all response rate was close to 90%. Out of 300 forms dispatched via courier service to the above mentioned urban and semi-urban zones; a total of 261 respondents returned the filled questionnaires. Sample size was calculated on the basis of amalgam waste that is 9.9% with margin of error 4% on 95% confidence level[13]. SPSS software (version 20.0) was used to tabulate and organize the data and reproduce the findings.

RESULTS

Most of the participants (around 65%) were based in the hospital setting (Figure 1). Dispensing methods showed an increased use of the encapsulated form of dental amalgam across both urban and semi-urban regions in Punjab at almost 60% (Table 1). The survey revealed that 75% of the respondents working in hospitals and 61% respondents in the private clinics chose the waste bin as their preferred method of discarding excess/waste dental amalgam and 12% of the respondents resorted to the sink as the go to disposal method. While 8% of the respondents claimed that they followed the proper recycling protocols for dealing with waste dental amalgam at chairside. Recycling rates fared slightly better in private clinics, with 13% of the participants claiming that they follow proper recycling protocols. Use of a photographic fixer solution appeared to be the least popular method for storing waste dental amalgam in both the hospital and clinic (Table 2). Moreover, the findings revealed that approximately 70% of the respondents performed an average of 20 amalgam restorations or less in a month (Figure 2). More than 80% of the respondents reported removing an average of 10 or less amalgam restorations per month (Figure 3).

DISCUSSION

The aim of this study was to highlight the waste dental amalgam management practices employed by dental hospitals and clinics in different regions of the Punjab province. The global shift away from the use of dental amalgam in the delivery of restorative oral healthcare is substituted by increasing frequency of use of alternative restorative materials. A large amount of

Table 1: Dental amalgam dispensing methods

Dispensing method	Frequency	Percent (%)
Handmix	98	37.5
Encapsulated	153	58.6
Both (Handmix+Encapsulated)	9	3.4
Total	261	100.0

Table 2: Preferred dental amalgam waste disposal and storing methods

Type of Practice	Disposal method (%)			
	Waste Bin	Sink	Recycling	Photographic Fixer
Hospital	75	12	8	4
Clinic	61	20	13	6

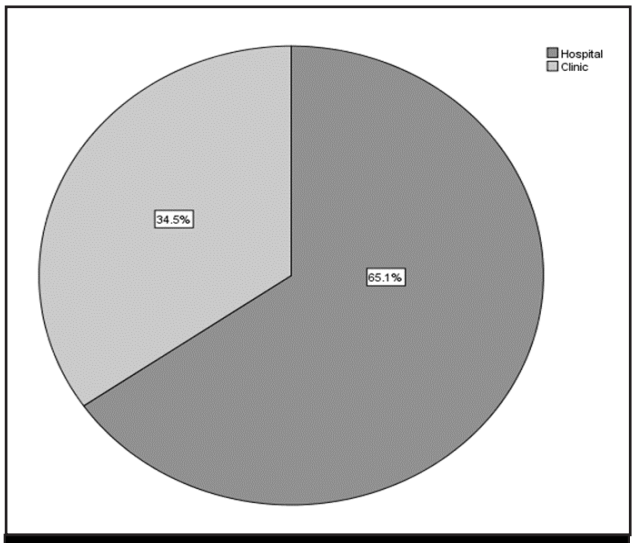

Fig. 1: Type of Dental Practice

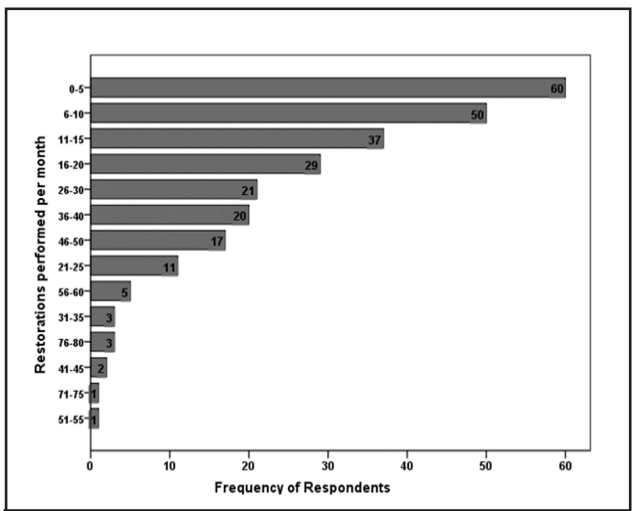

Fig. 2: Frequency of average number of dental amalgam restorations performed by respondents per month

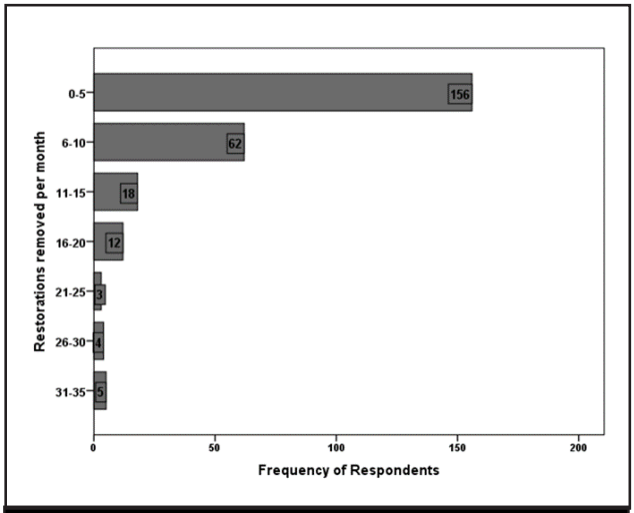

Fig. 3: Frequency of average number of dental amalgam restorations removed by respondents per month

exposure of the general population to mercury is mostly allocated to consumption of sea food (in the form of organic mercury, methyl mercury)[14] and dental amalgam[15], which may be in the form of elemental mercury and inorganic mercury[5]. The incidence of early onset dental caries and adult caries is considered a significant health affliction in both high- and low-income countries. Dental amalgam is still the mainstay dental restorative material in most regions, and efforts to implement control policies pertaining to unregulated flow of environmental Hg are ongoing[16]. A recent study by Lygre, Gunvor B., et al.[17] reported that amalgam restorations are not associated with an increased risk of attention deficit hyperactivity disorder in children exposed to dental amalgam from dental treatment of their mothers during pregnancy. However, important considerations and debates with respect to possible risk to the developing fetus as a result of amalgam restorations cannot be ignored.

Our study indicates that more amalgam restorations were placed each month as compared to restorations removed. These findings are also in agreement with our previous study in one large metropolitan city of Pakistan[18]. These differences in dental amalgam restoration and removal can partly be explained by factors such as affordability, longevity (durability), high compressive and wear resistance, ease of handling and placement of dental amalgams compared to contemporary restorative materials[19,20].

A strong response rate derived from this study pointed towards discarding of scrap amalgam in either the sink or waste bin, with minimal measures and incentives in place (in the vicinity of the practice) that could potentially encourage both staff and practitioners to follow the proper laid down protocols such as use of vacuum pumps, ISO standard compliant amalgam separators, and chairside traps for managing clinical dental amalgam waste. More importantly, these findings point to a lack of a proper waste stream and the implementation of associated best management practices guidelines (BMPs) for discarding waste dental amalgam at the provincial and national levels. This includes the absence of certified amalgam waste handling agencies and the separation of contact and non-contact amalgam from clinical waste.

The dental fraternity in Pakistan should take steps towards ensuring effective implementation of internationally laid down guidelines for a phase down of dental amalgam in light of persisting evidence backed concerns over alloy and mercury hazards to human health in particular and the environment in general. Legislations and capacity building for managing mercury waste are required at national level. Without these, a complete implementation of BMPs at the level of the end user cannot be effectively implemented. We will acknowledge here that dental amalgam is not the only source that is causing deleterious effects to environment and human health. Other main sources associated with these effects are mercury containing electronic item like batteries, switches, lamps, non-electronic measuring devices for instance sphygmomanometer, cement, and effluent from chemical industries[21]. The findings derived from this study will become part of a larger database conducted by this research group across Pakistan in other regions. Moreover, this work up forms part of the follow up investigation conducted in urban and semi urban localities of Sindh and Khyber Pakhtunkhwa. The investigations aim to map the handling and disposal practices of dental amalgam in Pakistan; as addressed in our previous works in this area[13,18].

There are some limitations of this study as the data relies on the self-reported practices of dental amalgam manipulation. Therefore, reported disposal practices and actual practices may vary. Our study reports the findings from some of the major urban and semi-urban zones in Islamabad and the Punjab province as part of an ongoing process to generate a mega study of analyses of amalgam disposal practices from other parts of Pakistan.

CONCLUSION

It was deduced that the findings revealed from this study correlate with data from our previous works in this area. Private clinics mostly discarded waste dental amalgam in the sink whereas hospitals preferred to discard excess dental amalgam in waste bins.

Respondents based in private clinic settings were slightly more inclined towards following prescribed recycling methods. The focus should be on controlling amalgam and mercury waste and optimizing the mixing and fixing of mercury with alloy, in order to minimize release of excess mercury in the environment and associated hazards.

Conflicts of Interest: The authors of this study declare no potential conflict of interest.

References

1. Bates MN. Mercury amalgam dental fillings: an epidemiologic assessment. Int J hyg envir heal. 2006;209(4): 309-16
2. Eggleston D. Dental amalgam: a review of the literature. Compendium. 1989;10(9):500-5
3. Anusavice KJ. Dental ceramics. Phillips' science of dental materials. 2003:655-719
4. Kefi KI, Maria MA, Majid MZ, Sana SJ, Afreen AM, Fareed FM, et al. Dental amalgam: effects of alloy/mercury mixing ratio, uses and waste management. J Ayub Med Coll Abbottabad (JAMC). 2011;23(4):43-5
5. Iqbal K, Asmat M. Uses and effects of mercury in medicine and dentistry. J Ayub Med Coll Abbottabad (JAMC). 2012;24(3-4):204-7
6. Swartz ML, Phillips RW. Marginal leakage of restorative materials. J. Am. Dent. Assoc.1961;62(2):141-51
7. Nakamura M, Kawahara H, Kataoka Y, Maehara S, Izutani M, Taguchi H. Biocompatibility of dental amalgams in vitro during 52 week period. Shika rikogaku zasshi. 1980;21(55):228-44
8. Batchu H, Rakowski D, Fan P, Meyer DM. Evaluating amalgam separators using an international standard. J Am Dent Assoc. 2006;137(7):999-1005
9. Jokstad A, Fan P. Amalgam waste management. Int Dent J. 2006;56(3):147-53
10. Khwaja MA, Nawaz S, Ali SW. Mercury exposure in the work place and human health: dental amalgam use in dentistry at dental teaching institutions and private dental clinics in selected cities of Pakistan. Rev environ health. 2016;31(1):21-7
11. Lynch CD, Wilson N. Managing the phase-down of amalgam: part II. Implications for practising arrangements and lessons from Norway. Brit Dent J. 2013;215(4):159-62
12. Lynch C, Wilson N. Managing the phase-down of amalgam: Part I. Educational and training issues. Br Dent J. 2013;215(4):159. 2013;215(3):109
13. Iqbal K, Asmat M, Kumar N, Mohsin F, Ali F, Hanif S. An Evaluation of disposal of mercury waste in dental teaching hospitals of Karachi. J Pak Dent Assocs. 2012;21(02): 108-111
14. Mason RP, Sheu GR. Role of the ocean in the global mercury cycle. Global biogeochem cy. 2002;16(4):40-1-14
15. Kim K-H, Kabir E, Jahan SA. A review on the distribution of Hg in the environment and its human health impacts. J Hazard mater. 2016;306:376-85.
16. Selin H, Keane SE, Wang S, Selin NE, Davis K, Bally D. Linking science and policy to support the implementation of the Minamata Convention on Mercury. Ambio. 2018;47(2):198-215
17. Lygre GB, Aase H, Haug K, Lie SA, Björkman L. Prenatal exposure to dental amalgam and risk of symptoms of attention-deficit and hyperactivity disorder (ADHD). Community Dent Oral Epidemiol. 2018;46(5):472-81
18. IQBAL K, Ali S, Mohsin F. Amalgam waste disposal in dental hospitals of Peshawar. Pak Oral Denatl J.2012;32(3)
19. Uçar Y, Brantley W. Biocompatibility of dental amalgams. Biocompatibility of Dental Biomaterials: Elsevier; 2017. 95-111
20. Lynch C, Farnell D, Stanton H, Chestnutt I, Brunton P, Wilson N. No more amalgams: Use of amalgam and amalgam alternative materials in primary dental care. Br Dent J. 2018; 225(2):171-176
21. Sultan MMBA, Ta GC, Peterson PJ, Puteh SEBW, Mokhtar MB. Mercury-added products management: Challenges in developing countries and lessons learned from medical facility. Malaysian J Pub Health Med. 2017;17(1):59-68