

치과의료기관별 의료폐기물 관리 현황 파악

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Identifying Medical Waste Management Status by Different Types of Dental Institutions

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ABSTRACT

Objectives: We aimed to examine whether dental waste was being managed adequately at different types of dental institutions in City D in South Korea.

Methods: The staff responsible for disinfection at 101 dental offices and clinics (six dentistry departments of general hospitals, 12 dental hospitals, and 83 dental clinics) was interviewed.

Results: Solid suction pump waste was handled appropriately at four of the general hospital dentistry departments (66.7%), six dental hospitals (50.0%), and 15 dental clinics (18.1%). Solid spittoon waste was handled appropriately at four general hospital dentistry departments (66.7%), seven dental hospitals (58.3%), and 14 dental clinics (16.9%). Developer and fixer were handled appropriately by a subcontractor at two general hospital dentistry departments (100.0%), five dental hospitals (100.0%), and 24 dental clinics (75.0%). Impression materials were handled appropriately at four general hospital dentistry departments (66.7%), six dental hospitals (50.0%), and 11 dental clinics (13.3%). The plastic covers of intra-oral radiography films were handled appropriately at five general hospital dentistry departments (100.0%), eight dental hospitals (72.7%), and 22 dental clinics (30.1%).

Conclusion: South Korea must implement detailed and specialized guidelines for the disposal of solid and general medical waste from dental institutions. Moreover, waste disposal training should be provided annually, and not only once every three years.

Keywords: Dental facilities, dental waste, medical waste disposal, Republic of Korea

I. Introduction

The US Environmental Protection Agency (EPA)¹⁾ defines medical waste as solid waste generated during the diagnosis, treatment, and vaccination of humans or animals; from related research; and during the production and trials of biological

formulations.

The US is the leading producer of medical waste, generating >3.5 million tons per year and spending an average of US\$790 per ton annually to dispose of this waste.²⁾ In the past few years, the number of medical institutions has been increasing in Korea. With a growing demand for dental treatment, the

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number of dental institutions (hospitals and clinics, in particular) has also been rising rapidly (from 16,742 dental institutions in 2014 to 17,172 in 2015 and 17,598 in 2016).³⁾ This trend has led to an increase in the amount of medical waste produced (154,719 tons, 171,717 tons, and 203,261 tons in 2013, 2014, and 2015, respectively).⁴⁾

The US classifies medical waste as infectious and non-infectious waste and manages the two categories separately. The management of infectious waste has been temporarily regulated and legislated through the Medical Waste Tracking Act as well as the guidelines and adherence times for the incineration of hospital, medical, and infectious waste.⁵⁾ The Medical Waste Tracking Act (created in 1988) was implemented to evaluate whether hospital waste was being properly disposed of. Although this law expired in 1991, some states (including Arkansas, California, Florida, New Mexico, South Carolina, Texas, Virginia, and West Virginia) continue to adhere to the Medical Waste Tracking Act, and most states monitor the proper disposal of medical waste irrespective of state law.⁶⁾

In Korea, isolation, harmful, and general medical waste are managed separately.⁷⁾ Harmful medical waste is further divided into tissue waste, sharps, and blood-contaminated waste. Tissue waste includes extracted teeth, blood, pus, and blood products; sharps include surgical blades, dental needles, and suture needles; and blood-contaminated waste refers to any waste that requires specific management because it contains a quantity of blood that poses a risk of leakage. General medical waste includes cotton wool, gauze, and disposable syringes that contain blood, body fluids, or secretions.⁷⁾ The Ministry of Environment recommends that heavy metal-containing radiographic developer and fixer as well as amalgam fillings and surplus amalgam after removal should be classified as general medical waste and disposed of by a subcontractor.⁸⁾ There is a growing interest in mercury toxicity in relation to dental amalgam. Dental amalgam is composed of 43-53% mercury

and the toxicity of mercury compounds mostly affects the central nervous system but can also affect the kidneys and the immune system.⁹⁾

Ananth et al.¹⁰⁾ presented recommendations for medical waste management based on a study of 12 Asian countries (Cambodia, China, Japan, Lao PDR, Thailand, Vietnam, Singapore, Malaysia, Mongolia, Myanmar, Indonesia, and Philippines). Kumar et al.¹¹⁾ analyzed changes in the behavior of medical workers in Pakistan after receiving education in medical waste disposal. In India, Kapoor et al.¹²⁾ performed a systematic review of six studies and identified a lack of knowledge and awareness regarding adequate biomedical waste management in dental researchers and students as well as considerable differences between different types of staff in medical waste management. Related studies of dental waste management have also been conducted in Iran¹³⁾ and Saudi Arabia.¹⁴⁾

In Korea, Oh et al.¹⁵⁾ examined the state of medical waste disposal at general hospitals, and Kim and Sakong¹⁶⁾ surveyed the state of dental waste management at dental clinics in three small- and medium-sized cities. However, to the best of our knowledge, there have been no reports on medical waste disposal at different types of dental institutions in Korea. The results of such a study can be used as reference material for the establishment and enactment of related laws.

Hence, we aimed to examine the state of medical waste management at different types of dental institution (dental hospitals and dental clinics) in Korea.

II. Materials and Methods

1. Study design and sampling

Among 760 dental offices and clinics that are registered in D City, we excluded specialist orthodontic and oral medicine clinics with little medical waste production. We included 7 dentistry departments of general hospitals as well as 12 dental hospitals;

moreover, we extracted a proportionate stratified sample of 83 dental clinics from the 8 districts in D City. After excluding 1 dentistry department of a general hospital that provided inconsistent data, a total of 101 dental hospitals and clinics were included in the final analysis.

2. Data collection and questionnaire

A researcher visited each participating institution and conducted interviews with the staff responsible for disinfection (dental hygienists, nursing assistants, and disinfection specialists) who had worked at the corresponding dental institution for at least 4 months and consented to participate in the study after hearing an explanation of the research objectives. A total of 101 staff (1 person per institution) were interviewed. This research was approved by the Institutional Review Board of Yeungnam University (No. YU201703004001-UE002). The study participants provided written informed consent.

The questionnaire included six questions on the respondent's general characteristics (age, educational attainment, job title, work experience, job responsibilities, and if they ever received education in waste management), three questions on the general characteristics of the dental institution (number of dentists, year of opening, and daily number of patients), one question on liquid waste disposal (radiography developer/fixer), and three questions on solid waste disposal (suction pump and spittoon solid waste, general medical waste).

3. Statistical analysis

The collected data were analyzed using SPSS ver. 23.0 (SPSS Inc., Chicago, USA). We performed a frequency analysis and used the Chi-square test to analyze the medical waste disposal by the type of dental institution.

III. Results

1. General characteristics of the respondents and dental institutions

The mean age of the respondents was 29.7 ± 6.4 years, and their mean work experience was 7 years and 3 months (± 6 years and 3 months). The most common highest educational level was 'professional school graduate' (71/101 respondents, 70.3%), and the most common job title was 'dental hygienist' (76/101 respondents, 75.2%). Regarding job responsibilities, 82 individuals (81.2%) responded that they assisted medical care. A total of 80 individuals (79.2%) reported that they had not received any education on waste management.

Most dental institutions had 1 dentist (52 institutions, 51.5%). The most common year of opening was between 1996 and 2005 (38 institutions, 37.6%), and the most common daily number of patients was ≤ 29 persons (40 institutions, 9.6%; Table 1).

2. Solid suction pump (a), spittoon (b), developer and fixer (C), impression material (d) and radiography film plastic cover (e) disposal by type of dental institution

Solid suction pump waste was disposed of appropriately (as a medical waste) at 4 dentistry departments of general hospitals (66.7%), 6 dental hospitals (50.0%), and 15 dental clinics (18.1%); the differences in the rate of adequate waste handling between the types of institutions were statistically significant ($p=0.003$). Solid spittoon waste was handled appropriately (as a medical waste) at 4 dentistry departments of general hospitals (66.7%), 7 dental hospitals (58.3%), and 14 dental clinics (16.9%); the differences were statistically significant ($p<0.001$).

Radiography developer and fixer were appropriately

Table 1. General characteristics of the respondents and dental institutions

Characteristic	Response	<i>n</i> (%) (Total <i>n</i> =101)
Education	High school graduate or lower	17 (16.8)
	Professional school graduate	71 (70.3)
	College graduate or higher	13 (12.9)
Job title	Dental hygienist	76 (75.2)
	Nursing assistant	15 (14.9)
	Other	10 (9.9)
Job responsibilities	Assisting medical care	82 (81.2)
	Disinfection	4 (4.0)
	Consultation and administration	15 (14.9)
Received education in waste control methods	Yes	21 (20.8)
	No	80 (79.2)
Number of dentists	1	52 (51.5)
	2	25 (24.8)
	≥3	24 (23.8)
Year of opening	1995 or earlier	33 (32.7)
	1996-2005	38 (37.6)
	2006 or later	30 (29.7)
Daily number of patients	≤29	40 (39.6)
	30-49	29 (28.7)
	≥50	32 (31.7)

handled by a subcontractor at 2 dentistry departments of general hospitals (100.0%), 5 dental hospitals (100.0%), and 24 dental clinics (75.0%; $p=0.333$). Only 39 (2 dentistry departments of general hospitals, 5 dental hospital, and 32 dental clinics; 39%) of the dental institutions analyzed in this study reported using developer and fixer.

Bloody impression materials were handled appropriately (as a medical waste) at 4 dentistry departments of general hospitals (66.7%), 6 dental hospitals (50.0%), and 11 dental clinics (13.3%); the differences in the rates of appropriate waste management were statistically significant ($p<0.001$). Blood-soiled radiography film plastic covers were handled appropriately (as a medical waste) at 5 dentistry departments of general hospitals (100.0%, as 1 institution did not respond to the survey), 8 dental hospitals (72.7%), and 22 dental clinics (30.1%); these differences were again statistically significant

($p<0.001$; Fig. 1).

IV. Discussion

The improper disposal of medical waste by dental institutions increases the risk of exposure to contaminants among workers and visitors; moreover, inappropriately disposed disinfectants and chemicals can cause contamination of the ecosystem and interfere with biological sewage processing.¹⁷⁾

Solid waste collected from suction pumps and spittoons can include amalgam waste. Amalgam has been widely used as a dental filler material for decades.¹⁸⁾ Amalgam is 50% mercury; the rest is mostly silver with small amounts of copper, tin, and zinc.¹⁹⁾ During dental treatment, if amalgam enters the waste water together with water used during washing, or if amalgam caught in the suction pump or spittoon filter is not properly disposed of, it can

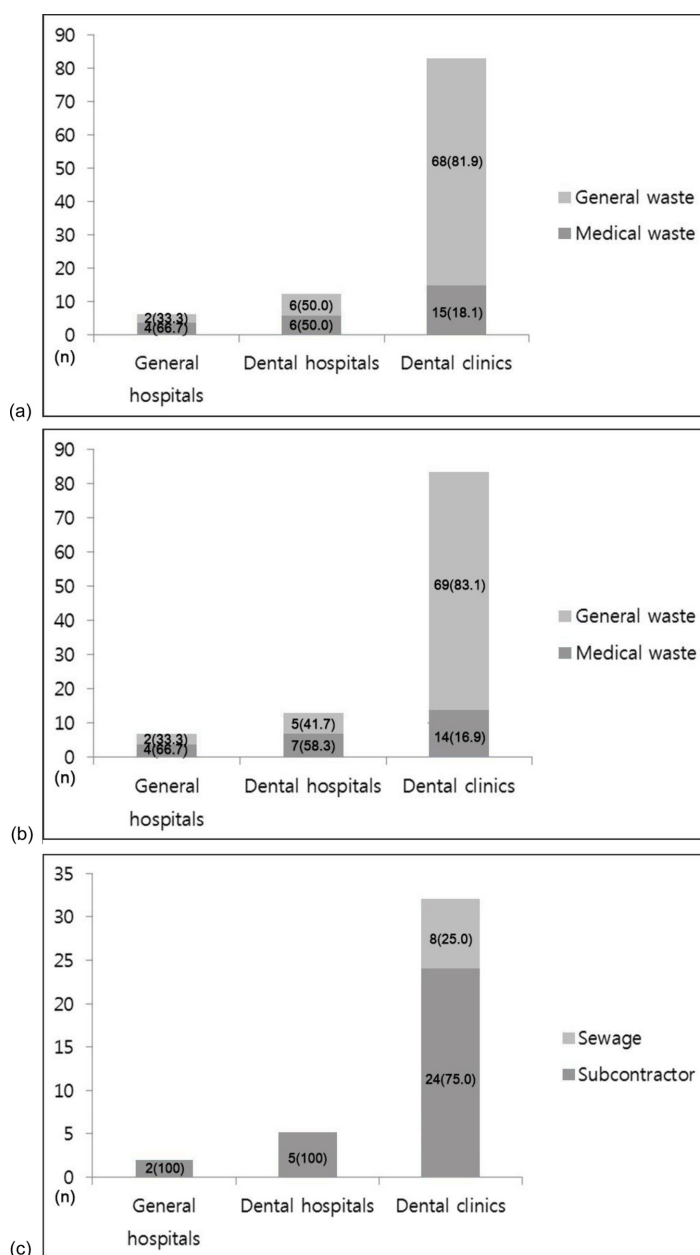


Fig. 1. Solid suction pump (a), spittoon (b), developer and fixer (C), impression material (d) and radiography film plastic cover (e) disposal by type of dental institution.

cause health impairments and environmental pollution. Our study found that solid suction pump and spittoon wastes were not being properly handled in a high proportion of dental clinics (>80%). Moreover, a very large proportion of dental clinics did not

dispose of their medical waste properly. Generally, dentistry departments of general hospitals showed the highest rate of adequate medical waste disposal. This rate was lower at dental hospitals and even lower than that at dental clinics.

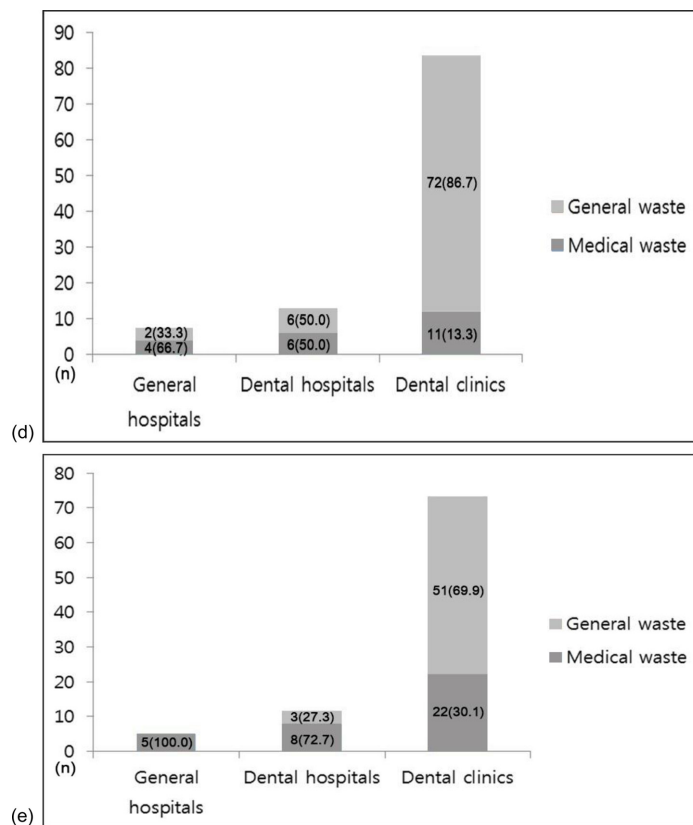


Fig. 1. Continued.

The American Dental Association has reinforced the use of safe disposal methods for amalgam; for example, from October 2007 onwards, amalgam separators that can remove >95% of mercury from wash water during amalgam treatment in a unit chair should be utilized.²⁰⁾ In October 2013, Japan and the European Union adopted the Minamata Convention on Mercury, aimed at reducing mercury emissions by banning 18 mercury-based amalgam-containing products between 2018 and 2020, restricting the supply and international trade of mercury, and compiling catalogs of manufacturing processes.²¹⁾ Therefore, Korea must establish alternative filler materials and methods for removing the mercury contained in dental amalgam as well as investigate the amounts of amalgam used and mercury removed from amalgam.

Radiographic developer and fixer solutions contain heavy metals such as silver, lead, and chromium. Therefore, these solutions should be disposed of by a subcontracted specialist waste disposal company.²²⁾ In Korea, dental radiographic devices are becoming increasingly digitalized; therefore, only 39 of the dental institutions analyzed in this study (39.0%) reported using developer and fixer. Of these, 8 dental clinics treated these solutions like regular sewage, indicating that re-education on the proper disposal of these types of waste should be provided to dental clinics.

Impression materials, bloody plastic covers used in digital radiography, and cotton wool for extracted teeth typically contain blood, bodily fluids, and secretions and should therefore be classified as general medical waste.⁸⁾ Nevertheless, we found that

this general medical waste was sometimes being disposed of using the same methods as regular garbage; this issue was more prominent in dental hospitals than in dentistry departments of general hospitals and more prominent in dental clinics than in dental hospitals. Accordingly, new policies for the management of these types of waste are required.

The World Health Organization notes the following causes of failed waste control: lack of awareness of the health risks posed by medical waste, inappropriate education on waste management, the absence of waste management or a waste system, lack of financial or human resources, and low prioritization of waste management.²³⁾ In our study, we observed that waste management at dental institutions was inadequate. In particular, medical waste management was worse at dental hospitals than at general hospitals, and worst at dental clinics. Although not shown, these results are thought to be related to the number of respondents reporting having received some education on waste management methods at each type of dental institution; these included 4 staff at dentistry departments of general hospitals (66.7%), 2 at dental hospitals (16.7%), and 15 at dental clinics (18.1%). In other words, differences in waste management education between different types of dental institutions could affect the adequacy of waste management.

Our study had one major limitation. The analysis was restricted to D City; thus, the sample cannot be assumed to be representative of all dental institutions in Korea.

Nevertheless, this study provides valuable evidence as, to the best of our knowledge, it is the first report to investigate the state of medical waste management at different types of dental institutions in Korea. Wider-reaching surveys should be conducted in Korea in the future. The lack of legal regulations regarding dental medical waste disposal in Korea is also highlighted as a problem. In the future, there is a need to study ways to identify and improve the causes of noncompliance with the dental health

waste disposal regulations.

V. Conclusions

A total of 80 individuals (79.2%) reported that they had not received any education on waste management. Therefore detailed and specialized management guidelines for solid and general medical waste disposal at dental institutions should be developed. Moreover, the current system of waste disposal education should be changed from once every three years to once yearly.

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