DOI Number: 10.37506/v20/i1/2020/mlu/194554

Measurement and Analysis of Exposure Dose According to Radiological Survey Films of Dental Hygiene Students in Oral Imaging Practice

Kam Ji Young[1], Yamaguchi Tokutaro[2], Lim kun Ok[3]

[1]Professor, Department of Dental Hygiene, SunMoon University, Asan, [2]Professor, Department of Pharmaceutical Engineering and Biotechnology, Sun Moon University Korea, [3]Professor, Department of Dental Hygiene, College of Health Science and Genome-based BioIT Convergence Institute, Sun Moon University, Asan

Abstract

Background: The class of oral imaging practice in undergraduate course of the department of dental hygiene is very important to enhance work performance of dental hygienists' radiologic examination after students graduate.

Method: We divided inside and outside of 8 exposure dosimeters into shielded ones and unshielded ones, performed irradiation 1,000 times, 2,000 times and 3,000 times respectively and compared and analyzed depth dose, shallow dose and accumulation dose.

Findings: The accumulation dose of shielded ones examined 1,000 times, 2,000 times and 3,000 times was 0.1 msv, which doesn't exceed 1 msv of normal person's dose limit and 50 msv of occupational dose per year by International Commission on Radiological Protection Recommendation. All of the examinations were safe results regardless of frequency, and when they were unshielded, it was 1.23 msv at 1,000 times of examination, 29.25 msv at 2,000 times and 40.26 msv at 3,000 times, which indicates the higher the frequency is, the higher the exposure dose, showing the importance of shield.

Improvement: We intend to provide a basic resource that in the undergraduate course of the department of dental hygiene, learning radiologic examination technique through actual mutual practice rather than pandom practice in the irradiation practice is more effective and safer.

Keywords: *Department of dental hygiene, dental hygienist, oral imaging, examination practice, exposure dose, shield.*

Introduction

According to Article 2, Clause 1, Section 6 of Enforcement Decree of the Act on Medical Articles, etc., dental hygienists can perform radiography for oral diagnosis at health agency or medical institution that has radiation generating device for diagnosis suitable for safety management standards[1]. and the radiography at dental institution is mostly done by dental hygienists.[2].

Kim[3] claimed that dental hygienists play a main role at dental clinics as staff of radiography, and as the level of their knowledge and attitude is higher, the level of radiography defense behavior is higher. Lee[4] revealed in the research on radiation safety management that the level of knowledge about radiation safety management is higher, the level of the attitude and behavior is higher, and the level of the attitude is higher, the degree of behavior is higher in the relation among the knowledge, attitude and behavior of radiation safety management.

However, the use of radiation in the medical field provides critical benefits in diagnosis and treatment, but it can't be denied that there are damages caused by radiation exposure[5].

The exposure by dental radiation is remarkably lower than other diagnostic medical radiographic inspections, but the frequency is very high[6].

Therefore, when irradiation is done, the choice of radiation generating device and irradiation dose is needed according to the purpose, irradiated part, and patient's characteristics, and the understanding on the physical property of radiation along with the knowledge and experience required in the application to device and technique should be accumulated[7].

The clinical performance ability, an important performance index of the dental hygiene education, is a critical part to evaluate the performance ability as a dental hygienist after a student graduates. The clinical practice education is an integrated form of all curriculums and becomes direct education for a dental hygienist's duty and responsibility by giving the behavior change in the knowledge, technique and attitude that a student acquires[8].

Thus, this study is intended to reveal dental hygiene students obey safety levels of exposure dose, perform safety regulations, and the accumulation dose is safe in their performance as radiation workers, and to provide a basic resource that in the undergraduate course of the department of dental hygiene, learning radiologic examination technique through actual mutual practice rather than pandom practice in the irradiation practice is more effective and safer.

Method

1. **Measurement tool:** We implemented an experiment using 8 personal exposure dosimeters offered by Seoul Radiology Services for research purpose from January 1 to March 31, 2019. After attaching each number to the exposure dosimeters for distinction in order to reduce errors during the experiment, we irradiated and performed a radiation exposure experiment using rootapex shooting equipment in the oral imaging laboratory of Sunmoon University.
2. **Measurement method:** We measured the exposure dose by dividing the exposure dosimeters in the root apex shooting room inside the oral imaging laboratory of Sunmoon University into inside and outside.

   The exposure dosimeters in the room were divided into 3 shielded ones and 3 unshielded ones, and 2 exposure dosimeters were set out of the door to find the amount of exposure dose out of the room with the doors closed during the X-ray irradiation.

   Regarding the frequency of irradiation, the 3 exposure dosimeters inside of the room were divided into 1000 times, 2000 times and 3000 times for accumulation irradiation, and the exposure dose was measured in the exposure dosimeters with the irradiation completed by a professional interpretation company.
3. **Analysis of date:** For the exposure dosimeters with the irradiation completed, we requested a professional interpretation company to compare and analyze exposure dose according to shielded and unshielded ones, and the frequency of shooting by dividing into depth dose, shallow dose and accumulation dose for precise analysis of exposure dose.

Result and Discussion

In dental medicine, radiographic inspection is useful in the diagnosis of oral diseases and the establishment of treatment plan, and as demands of orthodontics, denture and dental implant increase nowadays due to the improvement of income, the areas of radiographic inspection are expanded from intraoral radiography to external-oral radiography, panoramic radiography and digital radiography[9].

Accordingly, the clinical practice education to reinforce the field performance ability of dental hygienists, which are oral health specialists, is essential. The clinical training of the department of dental hygiene curriculum is the process that students actually perform the theory and practice that they learn during the undergraduate course at the dental clinic. Through this clinical training education, students can form their occupational values and improve capability as an oral medical specialists[10]. Yang and Moon[11] reported in their research that when the satisfaction level of clinical training is high, autonomic and responsible learning is performed, along with effective and efficiency clinical training education.

This study experimented the actual accumulation exposure dose and the importance of shielding by repeating irradiation based on 1,000 times of irradiation done during the radiation practice process, and compared and analyzed whether the irradiation act and exposure dose during the practice sessions during undergraduate course are safe. The results are as follows.

1. **Comparison of exposure dose levels according to irradiation accumulation frequency:** In the result of irradiation 1,000 times, 2,000 times and

3,000 times, the levels ofdirectly irradiated shallow exposure dose are 1.22 msv, 32.98 msv and 43.18 msv respectively, and those of depth dose are 1.23 msv, 29.25 msv and 40.26 msv in the same condition. [Table 1,Table 2,Table 3].

2. **Comparison of exposure dose levels according to shielding:** In the result of comparing the change of accumulation exposure dose levels according to shielding at irradiation of 1,000 times, 2,000 times and 3,000 times, when they were shielded, it was 0.1 msv according to irradiation frequency change, which indicates there is no change in levels, but there was a drastic change in the level of exposure dose when they were unshielded. In other words, the accumulation exposure dose irradiated 1,000 times was 1.23 msv, 2,000 times was 29.25 msv and 3,000 times was 40.26 msv, so as the frequency is higher, the levels of accumulation exposure dose are higher. [Figure 1].

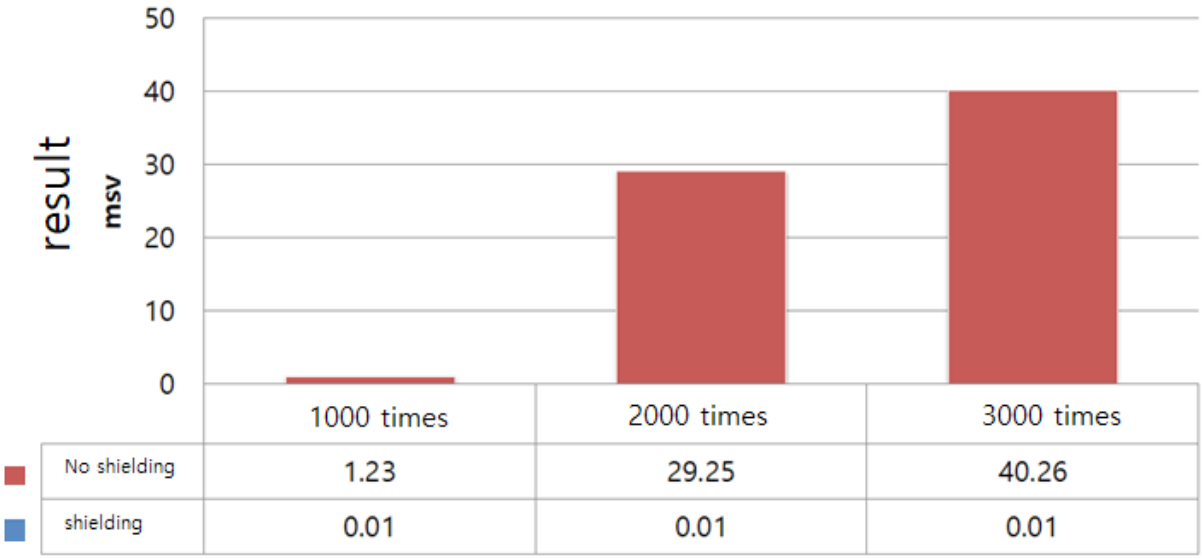

Fig. 1. Comparison of the cumulative measurement result figures among the results measured by radiation under different shooting conditions

Table 1. Exposure dose investigated 1000 times in radiation with different filming conditions

	Shallow	Depth	Yearly accumulation
No shielding	1.22	1.23	1.23
shielding	0.01	0.01	0.01
outside	0.02	0.02	0.02

Table 2. Exposure dose investigated 2000 times in radiation with different filming conditions

	Shallow	Depth	Yearly accumulation
No shielding	32.98	29.25	29.25
shielding	0.01	0.01	0.01
outside	0.02	0.02	0.02

Table 3. Exposure dose investigated 3000 times in radiation with different filming conditions

	Shallow	Depth	Yearly accumulation
No shielding	43.18	40.26	40.26
shielding	0.01	0.01	0.01
outside	0.02	0.02	0.02

Nuclear Safety And Security reinforced the safety management system on frequent visitors such as radiation safety education, implement of medical examination and maintenance of radiation exposure dose record by reflecting opinions that it is necessary to improve the safety management system for frequent visitors of radiation management zones as it revised Nuclear Safety Act in April, 2016[12-14].

Regarding overseas cases, International Commission on Radiological Protection recommends at ICRP 103 to classify the degree of risk of radiation work areas instead of classifying radiation workers and frequent accessors to maintain the management function for protection of radiation workers with occupational exposure, which means it recommends to reorganize radiation safety management system of frequent accessors by reflecting the degree of hazard of radiation access areas where students perform shooting practice[15-16].

According to the recommendation of International Commission on Radiological Protection(ICRP 60), the limit of exposure dose of normal people at planned exposure situations is 1 mSv per year, and occupational exposure shouldn't exceed maximum 50 mSv for one year, and the exposure limit is average 20 mSv for five years[17-18].

Therefore, workers who work in radiation controlled areas where medical radiologic equipment is operated are strictly managed by having them wear personal exposure dosimeter regardless of their work type[19].

This study confirmed that the actual accumulation exposure dose occurring in the training process of undergraduate course is within the safety level in the experiment of accumulation exposure dose based on the actual radiation exposure amount of personal exposure dosimeter that students wear during the radiology practice course in accordance with the radiation safety system.

Conclusion

This study researched the exposure dose of dental hygiene students during the oral imaging clinical practice course. Due to the regulation of Nuclear Safety Act, undergraduate students are not allowed to shoot directly at the mutual practice, so they do pandom practice, and directly shoot at the clinical field after they graduate. Even though both supervisors and students must execute radiation safety education, and the oral imaging practice is done in the safe environment under the management supervision, accurate practice and training for radiography in the undergraduate course are needed to reduce unnecessary radiation exposure dose in the clinical field, so I did the experiment of exposure dose in order to confirm that the accumulation exposure dose shot at the pandom during the oral imaging practice is thesafe level.

In addition, the experiment is done by being divided into shielding and unshielding to highlight the importance of shielding at the clinical practice and the clinical field.

The result shows that the accumulation dose of shielded ones examined 1,000 times, 2,000 times and 3,000 times was 0.1 msv, which doesn't exceed 1 msv of normal person's dose limit and 50 msv of occupational dose per year by International Commission on Radiological Protection Recommendation. All of the results were safe results regardless of frequency, and when they were unshielded, it was 1.23 msv at 1,000 times of examination, 29.25 msv at 2,000 times and 40.26 msv at 3,000 times, which indicates the higher the frequency is, the higher the exposure dose, showing the importance of shield.

The result of measuring exposure dose generating during the clinical practice shows that it is safe level to human body. The safety education for management of radiation exposure should be done from the school training courses to prevent radiation mistake or unnecessary radiation exposure. This study can be provided as a resource for revision of Nuclear Safety Act into actual irradiation for students to practice. Furthermore, there should be various comparison experiments and actual surveys on exposure dose based on the guidelines of dental clinicians' exposure safety management.

Ethical Clearance: Not required

Source of Funding: Self

Conflict of Interest: Nil

References

1. Kang EJ, Yoo BG: The study on the protection and actual condition of using the dental x-ray unit. J Korean Soc Radiol Tec, 2000, 23: 43-54.
2. Lee KH: A study on radiation safety management by dental hygienist. Unpublished master's thesis, Dankook University, Cheonan, 2004.
3. Kim SJ: An inquiry into dental personnel's knowledge, attitude and behavior about the defense against dental radiation. Unpublished master's thesis, Chungang University, Seoul, 2003.
4. Lee KH: A study on radiation safety management by dental hygienist. Unpublished master's thesis, Dankook University, Cheonan, 2004.

5. Lim Jae-dong: The Recognition of Safety Supervisor on Diagnostic Radiation Safety Rules. Master's Thesis of the Graduate School of Public Health at Yonsei University, 2000.
6. Lee W. Current status of medical radiation exposure and regulation efforts. J Korean Med Assoc 2011;54(12):124-52. https://doi.org/10.5124/jkma.2011.54.12.1248
7. Heo Jun: Radiation Technology towards 21st Century. Shinkwang Publishing Company, 1987, pp.17-19
8. J. R. Park, "Charateristics of College Students Majoring in Dental Hygiene and their Attitude on Clinical Training", Master's thesis. Daegu University of Kyungpook, 1991.
9. Kang EJ, Lee KH, Ju OJ: A study on the environmental condition and safety in dental radiographic room. J Korean Soc Dent Hyg, 2005, 5: 83-88.
10. H. G. Ryu, H. J. Wi & D. E. Jeong. (2017). The relationship between environmental factors causing stress in clinical practice institutions and the stress level of dental hygiene students. J Korean Clinical Health Sci, 2017, 5(3), 907-914. https://dx.doi.org/10.15205/kschs.2017.5.3907.
11. N. Y. Yang, S. Y. Moon, "The Impact of Health Status, Health Promoting Behaviors, and Social Problem Ability on College Adjustment Among Nursing Students", Journal of Korean Academic Society Nursing Education, 2013, Vol. 19, No. 1, pp. 33-42.
12. IAEA. Integrated Regulatory Review Service (IRRS) Guidelines for the Preparation and Conduct of IRRS Missions. International Atomic Energy Agency, 2013
13. T. H. Kim, S. W. Hong, N. S. Woo, H. K .Kim. & J. H. Kim.. The radiation safety education and the pain physicians' efforts to reduce radiation exposure. Korean J Pain, 30(2), 104-115. DOI : 10.3344/KJP.2017.30.2.104
14. H. H. Lee. & D. J. Park. A survey on the risk perceptions of employees in nuclear power plants. Korean Society of Safety,2017, 32(1), 134-139.
15. ICRP. ICRP Publication 103 - The 2007 Recommendations of the Int ernational Commission on Radiological Protection. The International Commission on Radiological Protection: Elsevier. 2007
16. International Atomic Energy Agency.. The Management System for Technical Services in Radiation Safety: IAEA Safety Standards Series. 2008.
17. International Commission on Radiological Protection, "The 2007 Recommendations of the International Commission on Radiological Protection", ICRP, 2007, Publication 103.
18. National instutite of food and drug safety evaluation, "Annual report on radiation exposure dose on persons engaged in radiation related job of medical institutes", KFDA, 2011.
19. SY Son, MA Jeong, "The Comprehension of health care service bill of radiological technologist and dental hygienist and the study of necessity of including the service supply resources", Journal of the Korea Academia-Industrial cooperation Society, 2011, vol. 12, no.4, pp. 1696-702. DOI: http://dx.doi.org/10.5762/KAIS.2011.12.4.1696