Original Article

Knowledge and Awareness of Dentists Working at Tertiary Care Hospital Towards Radiation Protection and Safety

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ABSTRACT

Background: Dental radiographs play a vital role in diagnosis and treatment planning of oral and maxillofacial regions through the use of ionizing radiation like X-Rays. These on the other hand also have harmful effects to our body. Even lesser amounts of radiation are harmful to the dental professionals and patients. Hence it is important to reduce exposure of radiation to prevent the harmful effects of ionizing radiation. Hence this present study was designed to assess the present knowledge and awareness towards radiation protection and safety among dental practitioners.

Methods: A descriptive, cross-sectional study was designed and conducted among 100 study participants. A self-administered close-ended questionnaire was used to collect the data. The data obtained was analyzed and measured by descriptive analyses and cross tabulations by SPSS-16.

Results: In this present study, 79(79%) of the participants thought that dental X-Ray is harmful whereas 21(21%) did not think it is harmful. Awareness of ALARA principle was seen among 88(88%) of the participants. About 77% of the participants considered thyroid as the most important organ to be protected during dental radiography while 90% of the participants confirmed to adhere to radiation protection in the future.

Conclusion: Knowledge and awareness of dentists in the study towards radiation protection and safety was seen to be insufficient in many arenas. Regular workshops should be facilitated at both the institutional and national level for motivating them towards maintaining radiation safety protocol.

Keywords: awareness, knowledge, radiation protection

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INTRODUCTION

X-Rays are used extensively in medical and dental practice which has both useful and harmful effects as it uses ionizing radiation like X-Rays. While they help us in diagnosis and treatment planning, they too cause harmful effects such as stochastic effects.[1] The free radicals produced as a result of ionizing radiation have harmful effects from DNA alterations to mutations. In dentistry, both intraoral and extraoral radiographs are used for diagnosis and treatment planning for dental disease.[1, 2]

In dentistry, usually the practicing dentist and the dental auxiliary are the one who are responsible for exposure and processing of radiographs. Even the exposure to radiation is less, the harmful effects of it cannot be ignored which ranges from a temporary or permanent biologic effect to the human body to higher risk of cancer. International Commission on Radiological Protection introduced safety protocols along with the As Low As Reasonably Achievable (ALARA) principle to lessen the unnecessary exposure of patients and practitioners to radiation and thus protect all the involved.[2-5]

A dental intraoral radiograph emit effective dose of 1.6 µSv to 8.14 µSv where as a medical abdomen X-Ray emit typical effective dose of 40 µSv to 1100 µSv. This signify that radiation doses emitted in dentistry are relatively low as compared to medical radiology. However, the radiation- protection protocols should be strictly followed by all general dental practitioners (GDP).[6, 7]

An understanding of radiation safety guidelines, principles and their application in practice are crucial for all the health professionals. Various studies had documented deficiencies in knowledge and awareness among dental practitioners and students concerning radiation doses, health risks and protection.[2,3] Lack of knowledge about the radiation exposure, risks and protection practices can be extremely dangerous to both operating dentists and their patients. Therefore, it is essential to assess the radiation safety knowledge and awareness in health care professionals. There have been few studies been performed on radiation safety but from the dental point of view such studies have not been reported in Nepal. In view of the increasing availability of new technologies such as CBCT and most widely used technology of taking radiographs in dental practices and the importance of dentist's knowledge and awareness towards radiation safety and protection is necessary, this study was aimed to assess the knowledge and awareness of radiation protection and safety among the dental practitioners and interns of Kathmandu Medical College and Teaching Hospital (KMCTH), Bhaktapur.

MATERIALS & METHODS

A cross sectional study was planned among dental practitioner and interns of Kathmandu Medical college and teaching hospital from July to October 2020 after getting ethical approval from Institutional Review Committee. Sample size was calculated using formula $n=Z^2pq/d^2$, taking p=85%=0.85,[8] q=1-p=0.15 at 95% confidence interval and d=7%=0.07. The sample size was calculated as 99.96. However, in the study we have included 100 subjects.

All the dentists and dental interns of KMCTH who gave informed consent were included in the study. A self-administered, closed-ended, questionnaire was employed to gather the socio-demographic characteristics, duration of practicing dentistry, assess the knowledge and awareness of radiation protection among dental practitioners. The questionnaire was adopted from previous studies[1,6,9,10] and modified after suggestions from the experts. The questionnaires consisted of two parts where Part I included demographic information and Part II had questions related to knowledge and practice. Data was collected and statistical analysis was done using SPSS version 16.

RESULTS

Among the participants, females were 69% whereas males were 31%. Majority of the participants were below 29 years of age (67%). The experience in dental practice was seen to be less than 5 years for majority of the participants (n=70, 70%). In terms of qualification, 70% had a bachelor's degree (BDS) while 30% had completed their masters (MDS).

Knowledge about radiation protection and safety was seen to be "adequate" among eighty-nine participants (89%) while 11% of participants had "inadequate" knowledge.

When asked if dental X-Ray was harmful, 79(79%) said yes while 21(21%) said no. On questioned if X-Ray beams reflect from room walls, 53(53%) said yes, 45(45%) said no while 2(2%) did not know. Awareness about radiation hazard symbol was seen in 83(83%) of participants while rest did not have any idea. Awareness of ALARA principle was seen among 88(88%) of the participants only.

Regarding radiographic equipment in their practice 89(89%) reported to have the equipment while 11(11%) agreed not to have it. The radiation safety plan if present in ones working dental practice was asked and 80% had while 20% of them did not. Maintenance of radiographic record/log book was asked and 80(80%) used to maintain them while rest did not. We also asked about the age of the radiographic equipment in used at their practice; more than half of the participants (n=53, 53%) had less than 5-year-old equipment.

All the participants were using cylindrical collimator for dental radiography. Among the participants, 89(89%) felt full mouth radiograph delivered more radiation to patient while 11(11%) considered panoramic radiograph. On questioned about the number of intraoral radiographs the participants took approximately per week; 57(57%) took less than 20 while 14(14%) did not know about the exact numbers. Thyroid was considered to be the most important organ to protect during dental radiography by 77% of the participants. On questioned if dental radiography is absolutely contraindicated in pregnant patients; 84% said no, 12% said yes while 4% did not know about it. Forty-one participants mentioned that the radiation tube head must be kept at the distance of 2-3 meters during exposure (Table 1).

Table 1: Knowledge and attitude-based questions regarding radiation protection and their responses

S. No	Questions	Options	Highest education		Total (n=100)
			BDS (n=70)	MDS (n=30)	
1.	Is dental X-Ray harmful?	Yes	57 (81.4%)	22 (73.3%)	79 (79.0%)
		No	13 (18.6%)	8 (26.7%)	21 (21.0%)
2.	Do X-Ray beams reflect from room walls?	Yes	38 (54.3%)	15 (50%)	53 (53%)
		No	32(45.7%)	13 (43.3%)	45 (45%)
		Don't know	0 (0%)	2 (6.7%)	2 (2%)
3.	Are you aware of National council on radiation protection [NCRP] and International commission on radiological Protection [ICRP] recommendations?	Yes	39 (55.7%)	15 (50.0%)	54 (54.0%)
		No	26 (37.1%)	12 (40.0%)	38 (38.0%)
		Don't know	5 (7.1%)	3 (10.0%)	8 (8.0%)
4.	Are you aware of the radiation hazard symbol?	Yes	57 (81.4%)	26 (86.7%)	83 (83.0%)
		No	13 (18.6%)	4 (13.3%)	17 (17.0%)
5.	Are you aware of ALARA principle?	Yes	65 (92.9%)	23 (76.7%)	88 (88.0%)
		No	2 (2.9%)	5 (16.7%)	7 (7.0%)
		Don't know	3 (4.3%)	2 (6.7%)	5 (5.0%)
6.	In your opinion, which among the following radiographic techniques deliver more radiation to the patient?	panoramic radiograph	4 (5.7%)	7 (23.3%)	11 (11%)
		full mouth radiograph	66 (94.3%)	23 (76.7%)	89 (89%)
7.	According to you, what is the most important organ to protect during dental radiography?	gonads	9 (12.9%)	5 (16.7%)	14 (14.0%)
		bone marrow	1 (1.4%)	2 (6.7%)	3 (3.0%)
		skin	3 (4.3%)	2 (6.7%)	5 (5.0%)
		thyroid	57 (81.4%)	21 (70.0%)	78 (78.0%)
8.	At which distance from the radiation tube head should you be positioned during exposure (m)?	< 1 meter	30 (42.9%)	7 (23.3%)	37 (37.0%)
		2-3 meters	25 (35.7%)	16 (53.3%)	41 (41.0%)
		>3 meters	15 (21.4%)	7 (23.3%)	22 (22.0%)
9.	Do you have a radiation safety plan in place in your dental practice?	Yes	55 (78.6%)	25 (83.3%)	80 (80.0%)
		No	15 (21.4%)	5 (16.7%)	20 20.0%)
10.	Do you maintain a Radiographic Record/Log Book in your dental practice?	Yes	62 (88.6%)	18 (60.0%)	80 (80.0%)
		No	8 (11.4%)	12 (40.0%)	20 20.0%)
11.	What shape does the tube head of your intraoral radiographic equipment have?	Cylindrical	70 (100.0%)	30 (100.0%)	100 (100.0%)
		Rectangular	0 (0%)	0 (0%)	0 (0%)
12.	Is dental radiograph absolutely contraindicated in pregnant patients?	Yes	7 (10.0%)	5 (16.7%)	12 (12.0%)
		No	61 (87.1%)	23 (76.7%)	84 (84.0%)
		Don't know	2 (2.9%)	2 (6.7%)	4 (4.0%)

Twenty-six of the participants did not know about the average exposure time for intraoral radiographs while 32% thought it to be 0.2 seconds. Majority (79%) mentioned that exposure time depended upon region of interest, film speed and tube voltage of equipment together.

On questioned about how the radiographic film/sensor is positioned during exposure, 93% used film/sensor holder, 6% used patient's finger and 1% used dentist finger. Majority of the participants (93%) used conventional film while rest preferred digital image receptor (Table 2). The speed of the film used in conventional film was E speed by 58%

of the participants while 12% did not know about it.

Standing behind protective wall during exposure was seen in 92% of the participants. Lead aprons and thyroid collar on regular basis was used sometimes by 47% while 31% rarely used it. On asked for the reasons for not using it, 30% told that it is unavailable in the working area. To protect oneself from radiation during exposure, 75% of participants stand behind a protective barrier during radiation exposure. Exposure badge was seen to be worn by 95% of the participants. Forty-three participants (43%) offered protection to their patients from radiation during exposure. Ninety participants (90%) of the participants wished to adhere to radiation protection in the future while 8% were not sure and 2% did not want to adhere to radiation protection.

Table 2: Practice based questions given to participants and their responses

S. No	Questions	Options	Highest education		Total (n=100)
			BDS (n=70)	MDS (n=30)	
1.	How many intraoral radiographs do you approximately take weekly?	<20	36 (51.4%)	21 (70.0%)	57 (57.0%)
		20 to 40	16 (22.9%)	4 (13.3%)	20 (20.0%)
		41 to 80	4 (5.7%)	1 (3.3%)	5 (5.0%)
		81 to 120	2 (2.9%)	1 (3.3%)	3 (3.0%)
		>120	1 (1.4%)	0 (0.0%)	1 (1.0%)
		I don't know	11 (15.7%)	3 (10.0%)	14 (14.0%)
2.	Exposure time depends upon:	Region of interest	1 (1.4%)	1 (3.3%)	2 (2.0%)
		Film speed	5 (7.1%)	5 (16.7%)	10 (10.0%)
		tube voltage of equipment	7 (10.0%)	2 (6.7%)	9 (9.0%)
		All of the above	57 (81.4%)	22 (73.3%)	79 (79.0%)
3.	How is the radiographic film/sensor positioned during exposure?	Film / sensor holder	67 (95.7%)	27 (90.0%)	94 (94.0%)
		Patient's finger	3 (4.3%)	3 (10.0%)	6 (6.0%)
4.	Which type of radiographic receptor do you use most often?	Conventional film	68 (97.1%)	25 (83.3%)	93 (93%)
		Digital image receptor (CCD / CMOS)	2 (2.9%)	5 (16.7%)	7 (7%)
5.	Do you stand behind the protective wall during exposure?	Yes	69 (98.6%)	23 (76.7%)	92 (92.0%)
		No	1 (1.4%)	7 (23.3%)	8 (8.0%)

DISCUSSION

Radiographs are widely used indispensable diagnostic aid in dentistry which is also used in treatment planning as well as monitoring disease progression. The biological interaction of ionizing radiation on living organism or tissue may lead to changes in the electronic level immediately within a fraction of seconds of the exposure which may persist for a varied period of time and even pass the effect of ionizing radiation from one generation to another generation.

The principal risk of dentomaxillofacial radiography is the rare occurrence of radiation-induced cancer. The current concept of radiation protection is based on the linear no-threshold (LNT) hypothesis, which states that even at low doses there is chances of induction of a new cancer. Several lines of evidence indicate that the LNT model is

scientifically plausible.[11] Hence, dental professional should be well aware of the advantages and hazards associated with the use of X-Rays and must ensure that their patients avoid even the smallest unnecessary dose of radiation.

In this present study, 79 (79%) of the participants think that dental X-Ray is harmful whereas 21 (21%) do not think it is harmful which is concerning. This finding is consistent with the study done by Khan et al[9] in 2017 where they come across 75% of the participants think dental X-Ray is harmful. 45% of the participants in our study know that X-Ray does not reflect from the wall while rest does not know the correct answer. Similar finding is present in the study done by Khan et al.[9] in 2017 where it was found that 39.16% of the participants knows the correct answer.

The concept of ALARA is very important when radiology comes into picture which suggests that radiation should be as low which can be achieved within practical limits.[12] Awareness of ALARA principle was seen among 88(88%) of the participants similar to study by Khan et al[9] and Rela R.[3] Monitoring and controlling the stochastic effects of radiation is necessary. NCRP/ICRP has also recommended protocols for radiation protection.[10,13] More than half of the participants (54%) in the study were aware of the recommended protocols. This was higher than the study done by Sultan et al[6] where only 18.3% of graduates were aware but less than the study by Khan MM et al[9] where 87.5% were aware of the protocols.

Eighty four percent of the participants in our study did not know that dental x-ray was contraindicated during pregnancy in comparison to 60% of participants in study done by Khan et al.[9]

In the study, 90% of the participants confirmed to adhere to radiation protection in the future similar to study by Khan MM et al[9] while only 48% were reported to stick to the protocol in a study done by Swapna S et al.[10]
Lead aprons and thyroid collar on regular basis was rarely used by 31% of the participants in the study. The reported reasons for not using such shields was unavailability in the working area for 30% of the participants. A study conducted by Khan MM et al[9] have shown only few (5%) participants rarely used it. This study has shown only forty-three participants (43%) offered protection to their patients from radiation during exposure. Knowledge about radiation protection and safety was seen to be 'adequate' among eighty-nine participants (89%) while 11% of participants had 'inadequate' knowledge which was similar to study done by Garg et al.[18] Information and response bias are inevitable in questionnaire-based study hence adding to the limitations of the study.

CONCLUSION

Knowledge about radiation protection and safety was seen to be adequate among 89% of participants. Regular workshops should be facilitated at both the institutional and national level for motivating them towards maintaining radiation safety protocol.

REFERENCES

1. Javali R, Dantu R. Attitude and awareness about radiation protection among dental surgeons in North Karnataka: A questionnaire study. Journal of Indian Academy of Oral Medicine and Radiology. 2018;30(2):116. [FULL TEXT]

2. Ihle IR, Neibling E, Albrecht K, Treston H, Sholapurkar A. Investigation of radiation-protection knowledge, attitudes, and practices of North Queensland dentists. J Investig Clin Dent. 2019;10(1):e12374. [DOI]
3. Rela R. Knowledge, Attitude and Practice of Radiation Protection Protocols amongst Students of a Dental College. Dentistry. 2019;09(01). [DOI]
4. Shabani F, Hasanzadeh H, Emadi A, Mirmohammadkhani M, Bitarafan-Rajabi A, Abedelahi A, et al. Radiation Protection Knowledge, Attitude, and Practice (KAP) in Interventional Radiology. Oman Med J. 2018;33(2):141-7. [DOI]
5. Binti Abd Rahman F, Gurunathan D, Sudhan Vasantharajan M. Knowledge, Attitude And Practice Of Radiation Exposure Protection For Pediatric Patients Among Undergraduate Dental Students. Biomedical and Pharmacology Journal. 2018;11(2):1143-51. [DOI]
6. Sultan R, Parvez K, Qureshi H. Awareness About Dental Radiography Among Dental Students. Journal of The Pakistan Dental Association. 2018;27(03):147-52. [DOI]
7. Zafar M, Farhan A, Shaikh T, Rafiq R, Usman S, Abrar H, et al. Knowledge, attitude, and practices regarding radiological modalities among health-care providers, Karachi, Pakistan. International Journal of Health System and Disaster Management. 2016;4(4):132. [DOI]
8. Garg D, Kapoor D. Awareness Level of Radiation Protection among Dental Students. *JNMA J Nepal Med Assoc*. 2018;56(212):800-803. [DOI]
9. Khan MM, Katti C, Shahbaz S, Puranik K. Awareness of Biological Hazards and Radiation Protection Techniques of Dental Imaging-A Questionnaire Based Cross-Sectional Study among Dental Students and clinicians.Sch. J. Dent. Sci., 2017; 4(11):491-495. [FULL TEXT]
10. Swapna L, Koppolu P, Takarji B, Al-Maweri S, Velpula N, Chappidi V, et al. Knowledge on Radiation Protection & Practice among Dental Students. British Journal of Medicine and Medical Research. 2017;19(7):1-7. [DOI]
11. MallyaSM, Ernest W.N. Lam. White and Pharoah's Oral Radiology, Principles and Interpretation. 8th Ed. Elsevier: 2019.
12. Enabulele JE, Igbinedion BO. An assessment of Dental Students' _knowledge of radiation protection and practice. J Educ Ethics Dent. 2013;3(2):54. [DOI]
13. Prabhat M, Sudhakar S, Kumar BP. Knowledge, attitude and perception (KAP) of dental undergraduates and interns on radiographic protection-A questionnaire based cross-sectional study. J Adv Oralres. 2011; 2(3): 45-50. [DOI]