ORIGINAL ARTICLE

Knowledge, attitude and perception toward radiation hazards and protection among dental undergraduates, interns and dental surgeons – A questionnaire-based cross-sectional study

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Abstract

Background: Radiograph in dentistry is a routine tool in the diagnosis of maxillofacial conditions. It makes the use of ionizing radiations which are harmful to the oral tissues. To minimize those detrimental effects, it becomes imperative to have a thorough knowledge about the ionizing radiations, radiation hazards and radiation protection measures.

Objectives: The objectives of the study were to formulate an assessment with regard to the knowledge, attitude, and perception (KAP) of dental students, internees, and dental professionals toward ionizing radiations, radiation hazards and protocols of radiation protection.

Materials and Methods: The study consisted of 120 undergraduates (3rd year and 4th year) Bachelor of Dental Surgery (BDS) students who have completed their 30 days of posting in the Department of Oral Medicine and Radiology, 31 interns and 19 dental practitioners (n = 170). The participants were subjected to a structured questionnaire with multiple choices. The data was collected, compiled and subjected to statistical analysis using, SPSS Statistics for Windows, Version17.0. (SPSS Inc., Chicago). Pearson Chi-square test was used to evaluate the statistical significance.

Results: The present study revealed an overall correct response of 60.0%. Individually, 3rd year students gave a correct response of 50.0%, followed by 61.3% correct response by 4th year students, 64.3% by interns, and 64.5% by the dental practitioners.

Conclusion: The KAP level mentioned in the objectives was significantly higher in dental practitioners and least with undergraduate students. Thus, the outcome of the present study stresses on the need for incessant teaching so that the students are grounded well with the principles of dental radiography.

Introduction

X-rays are electromagnetic radiations made up of photons having short wavelength and high frequency which are used for diagnostic purposes.[1] In dentistry and they serve as a prime source of investigation to arrive at an apt diagnosis. Due to their ionizing nature and they are harmful to living tissues and causing changes at cellular and tissue levels. The degree of damage caused by the radiation exposure in dentistry is yet unknown.[2,3]

Biological effects of radiation can be categorized into direct and indirect effects. Direct effects are those in which living molecules absorb energy from ionizing radiation, whereas indirect effects facilitate damage by producing micromolecular alteration in the DNA. Biological effects of radiations can also be categorized as deterministic and stochastic effects.[4] Deterministic effects can

be defined as the response of the radiation, which is directly proportional to the applied dose of the radiation, whereas in stochastic effect, the probability of occurrence of the change, rather than its severity, is dose dependent.[4,5]

The International Commission on Radiological Protection (ICRP) took its first step to formulate risk versus benefit plan in 1977, where it advised that patient exposures should be justified and kept to the minimum.[6] The dental radiographs, thus, should be prescribed only for a patient when the benefit outweighs the risk of damage from radiation following As Low As Reasonably Achievable (ALARA).

During the clinical course of dentistry, undergraduates and interns had to undergo radiology postings, where they get exposed to radiation and in private practices the practitioner gets exposed while taking radiographs. The dental undergraduates belonging to 3rd and 4th year of BDS, the internees and the dental practitioners were the house officers as well as those working privately in the adjoining area, were included in the present study.

In the literature, the number of studies regarding the extent of radiation protection and safety measures which are being followed in Parsa District of Nepal are less; therefore, we decided to expand the concept of radiation safety and protection measures among dental practitioners, interns and dental students.

Materials and Methods

This cross-sectional questionnaire based study was conducted on 170 participants comprising 120 undergraduate dental students (57–3rd year and 63–4th year), 31 interns and 19 dental surgeons that included the house officers of M. B. Kedia Dental College and Teaching Hospital selected dental practitioners of Birgunj, Nepal, and its adjoining areas using convenience sampling. Approval from the Ethical Committee of the Institute was obtained and informed consent was taken from the participants.

Inclusion criteria

Dental undergraduates, interns, and dental practitioners who have completed at least 30 days of clinical postings were included in the present study.

Exclusion criteria

The dental undergraduates of 1st and 2nd year were not included since they have not reached the clinics and have not undergone radiology postings. Individuals not interested in the study and incomplete questionnaires were excluded from the study.

Methodology

A structured questionnaire was prepared and distributed among dental students, interns, and dental practitioners, consisting of 17 questions specially designed for the study.[7-10] The questionnaire has three categories:

In the first group, questions were there to classify the participants into undergraduate students, interns, and dental practitioners and to mention the gender of participants [Table 1]. The second group of questionnaire consisted of seven questions for the assessment of knowledge, attitude, and perception (KAP) toward radiation hazards [Table 2], whereas a third group of questionnaire consisted of ten questions for the assessment of KAP toward radiation protection methods and guidelines [Table 3].

Statistical analysis

The data were collected, compiled, and subjected to statistical analysis using the SPSS Inc. Released 2008, SPSS Statistics for Windows, Version 17.0. (SPSS Inc., Chicago). Pearson Chi-square test was performed to determine the statistical significance.

Results

The overall correct response of the participants on KAP toward radiation hazards and protection was 60.0%. Individually, 3rd year students gave a correct response of 50.0%, followed by 61.3% correct response by 4th year students, 64.3% by interns, and 64.5% by the dental practitioners.

A total of 170 participants were enrolled in the study of which 57 students (males – 15, and females - 42) were from 3rd year, 63 students (males – 17, and females – 46) were from final year, 31 students (males – 14, and females – 17) were interns, and 19 students were general dental practitioners (males – 16, and females – 3).

When asked "Are you aware of the radiation hazard symbol?" 129 (75.9%) participants gave correct response. The difference between the responses in all four groups was statistically non-significant ($\chi^2 = 9.0519$ with $P > 0.05$).

A total of 130 (76.4%) gave the correct answer to the question "Is dental X-ray harmful?" The difference between the responses in all four groups was statistically significant ($\chi^2 = 12.67$ with $P < 0.05$).

When asked "Do X-ray beams reflect from room walls"? Sixty (35.3%) participants revealed correct response. The difference

Table 1: Distribution of the participants based on group (academic year) and gender

Sex	Group												Total sample	
	3rd year students			4th year students			Interns			Dental surgeons			*n*	% of total
	n	% of 3rd year	% of total	n	% of 4th year	% of total	n	% of intern	% of total	n	% of dental surgeon	% of total		
Male	15	26.3	8.8	17	26.9	10.0	14	45.2	8.2	16	84.2	9.4	62	36.4
Female	42	73.7	24.7	46	73.1	27.1	17	54.8	10.0	03	15.8	1.8	108	63.6
Total	57	100	33.5	63	100	37.1	31	100	18.2	19	100	11.2	170	100

Table 2: Response of the participants to the structured questions group wise regarding radiation hazards

S. No.	Questions	Response	GROUP				Total (n)	%	*P*-value
			3rd year students	4th year students	Interns	Dental surgeons			
1.	Aware of radiation hazard symbol	Yes	46	47	22	14	129	75.9	0.17
		No	08	14	04	02	28	16.5	
		Don't know	03	02	05	03	13	07.6	
2.	Dental X-rays are harmful	Yes	35	49	28	18	130	76.4	<0.05
		No	19	13	03	01	36	21.2	
		Don't know	03	01	00	00	04	02.4	
3.	X-rays can be reflected from the room walls	Yes	34	21	20	13	88	51.8	<0.01
		No	10	38	08	04	60	35.3	
		Don't know	13	04	03	02	22	12.9	
4.	Awareness regarding deterministic and stochastic effects	Yes	08	31	18	13	70	41.2	<0.01
		No	19	18	09	02	48	28.2	
		Don't know	30	14	04	04	52	30.6	
5.	Awareness of ALARA principle	Yes	09	32	15	09	65	38.2	<0.03
		No	30	27	12	08	77	45.3	
		Don't know	18	04	04	02	28	16.5	
6.	Awareness regarding usefulness of filters and collimators in dental radiography.	Yes	41	57	27	17	142	83.5	0.23
		No	07	02	02	02	13	07.6	
		Don't know	09	04	02	00	15	08.9	
7.	Do you prefer to hold the film with your hand during exposure?	Yes	10	48	05	02	65	38.2	<0.01
		No	44	15	26	17	102	60.0	
		Don't know	03	00	00	00	03	01.8	

between the responses in all four groups was statistically highly significant ($\chi^2 = 31.70$ with $P < 0.01$).

Are you aware of deterministic and stochastic effects? 70 (41.2%) participants gave correct response. The difference between the responses in all four groups was statistically highly significant ($\chi^2 = 33.63$ with $P < 0.01$).

Are you aware of ALARA principle? Sixty-five (38.2%) gave correct response. The difference between the responses in all four groups was statistically significant ($\chi^2 = 13.918$ with $P < 0.05$).

Do you have the knowledge of the benefit of collimators and filters in dental radiography? One-hundred and forty-two (83.5%) participants showed correct response. The difference between the responses in all four groups was statistically non-significant. ($\chi^2 = 8.530$ with $P > 0.05$).

Do the operator hold the films during exposure? One hundred and two (60.0%) participants showed correct response. The difference between the responses in all four groups was statistically highly significant ($\chi^2 = 61.350$ with $P < 0.01$).

Do you tell the patient to hand-held the film during exposure? One hundred and eighteen (69.4%) participants showed correct response. The difference between the responses in all four groups was statistically significant ($\chi^2 = 19.028$ with $P < 0.05$).

Does high speed film need a reduced exposure? One hundred and three (60.6%) participants showed correct response. The difference between the responses in all the four groups was statistically highly significant ($\chi^2 = 28.794$ with $P < 0.01$).

Does digital radiography require less exposure than conventional? One hundred and twenty-four (72.9%) participants gave correct response. The difference between the responses in all four groups was statistically highly significant ($\chi^2 = 27.836$ with $P < 0.01$).

What is the accepted distance and position of the operator while making an intraoral radiographic exposure? Seventy (41.2%) participants showed correct response. The difference between the responses in all four groups was statistically highly significant ($\chi^2 = 32.213$ with $P < 0.01$).

Is it necessary for the operator to wear a radiation monitoring dosimeter? One hundred and sixteen (68.2%) showed correct response. The difference between the responses in all four groups was statistically significant ($\chi^2 = 13.116$ with $P < 0.05$).

Is dental radiograph absolutely contraindicated in pregnant patients? One hundred and three (60.6%) participants showed correct response. The difference between the responses in all four groups was statistically non-significant ($\chi^2 = 8.271$ with $P > 0.05$).

Are you aware of National Council on Radiation Protection (NCRP) and ICRP recommendations? Fifty-five (32.4%) participants gave correct response. The difference between the

Table 3: Response of the participants to the structured questions group wise regarding radiation protection measures

S. No.	Questions	Response	Group				Total (n)	%	*P*-value
			3rd year students	4th year students	Interns	Dental surgeons			
1.	Do you ask the patient to hold the film with their hands during exposure?	Yes	9	15	15	11	50	29.4	<0.04
		No	47	47	16	8	118	69.4	
		Don't know	1	1	00	00	2	01.2	
2.	High speed films require less exposure	Yes	20	49	23	11	103	60.6	<0.01
		No	15	8	5	5	33	19.4	
		Don't know	22	6	3	3	34	20.0	
3.	Digital radiography requires less exposure than conventional radiography	Yes	28	55	27	14	124	72.9	<0.01
		No	15	6	3	3	27	15.9	
		Don't know	14	2	1	2	19	11.2	
4.	Ideal position of the operator during exposure	4 ft, 90°–135°	6	12	11	2	31	18.2	<0.01
		4 ft, 60°–90°	15	9	00	3	27	15.9	
		6 ft, 90°–135°	17	28	15	10	70	41.2	
		6 ft, 60°–90°	1	3	3	3	10	05.9	
		Don't know	18	11	2	1	32	18.8	
5.	Personnel monitoring devices worn by the operator	Above the lead apron	31	43	26	16	116	68.2	<0.04
		Below the lead apron	2	4	2	00	8	04.7	
		Don't know	24	16	3	3	46	27.1	
6.	Dental X-rays are absolutely contraindicated in pregnancy	Yes	16	30	10	4	60	35.3	<0.30
		No	37	33	19	14	103	60.6	
		Don't know	4	00	2	1	7	04.1	
7.	Awareness regarding NCRP/ICRP recommendations	Yes	18	20	10	7	55	32.4	0.10
		No	27	30	14	9	80	47.0	
		Don't know	13	13	6	3	35	20.6	
8.	Will you adhere to the radiation protocol in future?	Yes	43	50	25	15	133	78.2	0.10
		No	6	6	3	2	17	10.0	
		Can't say	8	7	3	2	20	11.8	
9.	Do you use lead aprons regularly?	Yes	22	24	14	9	69	40.6	0.10
		Sometimes	18	13	9	6	46	27.1	
		Rarely	4	4	4	1	13	07.6	
		No	7	22	4	3	36	21.2	
		Don't know	6	00	00	00	6	03.5	
10.	If sometimes/rarely/not/don't know, why?	Non availability of the apron	10	24	9	6	49	48.5	<0.10
		Weight of the apron	2	2	2	1	7	06.9	
		Common apron for all	5	4	3	00	12	11.9	
		Follow position rule only	10	9	2	3	24	23.8	
		Not sure	8	00	1	00	9	08.9	

responses in all four groups was statistically non-significant ($\chi^2 = 0.485$ with $P > 0.05$).

Will you adhere to the radiation protection protocol in future? One hundred and thirty-three (78.2%) participants showed correct response. The difference between the responses in all four groups was statistically non-significant ($\chi^2 = 0.542$ with $P > 0.05$).

Do you use lead aprons on a regular basis? 69 (40.6%) participants showed correct response. The difference between the

responses in all four groups was statistically non-significant ($\chi 2 = 17.386$ with $P > 0.05$). Among 101 participants who were not using lead apron, 49 (48.5%) answered the non-availability of lead apron, 7 (6.9%) answered due to overweight, 24 (23.8%) were following only position rule, and 9 (8.9%) were not sure about the answer regarding the reason that they were not wearing the lead aprons. The difference between the responses in all four groups was statistically non-significant ($\chi^2 = 15.135$ with $P > 0.05$).

Discussion

In the past few years, numerous researches were conducted for the measuring radiation exposure and have revealed the increased occurrence of malignancies, abortions, teratogenicity, and reduction of life span.[11] Although, it may not hold good for diagnostic dental radiography, the possibility of radiation hazard cannot be discarded.[11] This situation has produced the concept of ALARA, which recognizes the possibility that no matter how small that dose is, some stochastic effect may result.[4,12]

The prime objective of radiation protection must consider to minimize the deterministic effects and to lessen the production of stochastic effects by reducing the radiation exposure of the patients and the operator.[4,11,12]

The forementioned objective can see life only when the operator has the knowledge of radiation protection and makes use of it in the clinics. In our study, undergraduates (3rd and final year of BDS) and internees were shortlisted as the study subjects as they have radiology in their routine curriculum. Selected dental professionals were also selected as they often used to take radiographs in their private clinics on regular basis. The close-ended questionnaire was prepared to ascertain a correct response in regard to knowledge, wherever the evaluation of attitude and perception was necessary, a leading question was asked to record a response.

Data obtained from this ongoing research revealed that 129 out of 170 (75.9%) participants were aware of the radiation hazard symbol whereas Srivastava *et al*. reported it to be 76.4%, Shah *et al*. as 83%, and Prabhat *et al*. as 89.[8,9,13]

As far as whether the X-rays are harmful, 130 out of 170 (76.4%) participants knew that X-rays are harmful. Arnout and Jafar reported 67% in Saudi students, Shah *et al*. as 75%, Srivastava *et al*. as 83.3%, Arnout as 88% in Egyptian students, and Prabhat *et al*. as 100%.[7-10,13]

Whether X-rays are reflected from the room walls, 60 out of 170 (35.3%) participants gave the correct response. In other similar studies, Arnout has reported it to be 18%, Arnout and Jafar as 33%, Srivastava *et al*. as 35.6%, and by Prabhat *et al*. as promising 88%.[7,9,10,13]

In this study, 70 of 170 (41.2%) participants were aware of the deterministic and stochastic effects. In other similar studies, Arnout and Jafar have reported it to be 33%, Arnout as 34%, Srivastava *et al*. to be 39.7%, and by Prabhat *et al*. as promising 84%. These results were surprising as dental radiography is a crucial part of diagnosis and treatment in oral health and all participants are already using or will use in future the dental radiography in their routine dental practice.[7,9,10,13]

Besides being a safety measure, ALARA also facilitates a regulatory tool for all radiation safety programs.[14] The results from the present study showed that only 65 of 170 (38.2%) participants knew about the ALARA principle; similarly, Arnout has reported it to be 33%, Srivastava *et al*. as 37.4%, Arnout and Jafar as 40%, Prabhat *et al*. as 84%, and Shah *et al*. reported a high of 98.6% whereas Enabulele and Igbinedion have reported a very low of 17.9%.[7-10,13,15]

Response to the question asked regarding the knowledge of usefulness of collimators and filters, the awareness was showed by 142 of 170 (83.5%) participants. Arnout has reported a low of 44%, Enabulele and Igbinedion as 50% and Arnout and Jafar reported an acceptable 73%, whereas Srivastava *et al*. and Prabhat *et al*. have reported a high of 88% and 90%, respectively.[7,9,10,13,15]

To achieve optimum safety, the operator should not hold the film in place for the patient during the procedure. In this study, 102 of 170 (60.0%) participants were aware about that they need not hold the films during exposure. Similarly, Arnout and Jafar have reported an incidence of 46.7%, Srivastava *et al*. as 58.6%, Arnout as 94%, and Prabhat *et al*. have reported as high as 97%.[7,9,10,13]

One hundred and eighteen of 170 (69.4%) participants answered that they do not follow the practice where the radiographic film is hand-held by the patient. Arnout reported astonishingly as low as 6.66%, Arnout and Jafar as 40% whereas Prabhat *et al*. and Srivastava *et al*. have reported as high as 64% and 71.8%, respectively.[7,9,10,13]

High speed films are efficient in reducing radiation doses. Speed of the film depends on the size, shape, and orientation of the photosensitive crystals. Recent research indicates that F-speed films have a similar or higher contrast compared to Ektaspeed Plus Films and reduce patient exposure up to 20%. In this context, 103 out of 170 (60.6%) participants were aware that high speed film requires less exposure. Arnout and Jafar reported 47%, Srivastava *et al*. as 62.6%, and Arnout reported 66% whereas Prabhat *et al*. and Shah *et al*. reported a good response of 78% and 87%, respectively.[7-10,13]

In the current study, 124 of 170 (72.9%) participants had the awareness that the amount of exposure required for digital radiography is less than conventional radiography. Prabhat *et al*. have reported it to be 75%, Srivastava *et al*. as 76%, Arnout as 86%, and Shah *et al*. reported a promising 88% whereas Arnout and Jafar have reported it to be as low as 40%.[7-10,13]

The position of the operator during exposure should be six feet away from the patient chair at the angle of 90°–135° to the central beam. On application, this rule takes the advantage of the fact that in this position, the patient's head absorbs most scattered radiation.[16] Only 70 (41.2%) of 170 participants knew about the correct position and distance rule. The correct response to this question in similar studies was found to be 40.2% by Srivastava *et al*., 41% by Enabulele and Igbinedion, 53% by Arnout and Jafar, and 65% by Arnout whereas both Shah *et al*. and Prabhat *et al*. reported a high 87%.[7,8,10,13,15]

The personnel's in the X-ray room are required to wear radiation monitoring dosimeters up to 3 months. The dose of radiation exposure accumulated in the specified period is measured by the designated dosimetry service provider and sent

to employer for monitoring purpose.[17] In the present study, 116 of 170 (68.2%) participants were aware that personal monitoring badges should be worn by operator during exposure. Shah *et al.* reported a low incidence of 29%, Arnout and Jafar reported an average 40%, Srivastava *et al.* as 69.5% and Arnouthas reported a high of 78%.[7,8,10,13]

In the current study, 103 of 170 (60.6%) participants were aware that the X-rays are not absolutely contraindicated in pregnancy. In other similar studies, Arnout and Jafar have reported it to be 20%, Prabhat *et al.* as 59%, Srivastava *et al.* as 59.8%, and Shah *et al.* as 65%, whereas Arnout has reported it to be 67%.[7,8,9,10,13] However, the practitioners should take all possible precautions to minimize the risk, including use of lead apron and thyroid collar.

Current recommendations of the NCRP and measurements relative to ionizing radiation are based on radiation protection principles.[18] In the present study, 55 out of 170 (32.4%) participants were aware of NCRP and ICRP recommendations. However, Arnout and Jafar have reported it to be 20%, Arnout as 27%, and Shah *et al.* as 56% whereas Prabhat *et al.* have reported a high of 94%.[7-10]

One hundred and thirty-three out of 170 (78.2%) participants were willing to adhere to radiation protection protocols in future in the current study. Prabhat *et al.* and Srivastava *et al.* have reported an incidence of around 81%, Arnout as 82% and Shah *et al.* as 89% whereas Arnout and Jafar have reported an average of 53% participants willing to adhere to radiation protection protocols.[7-10,13]

The use of lead apron can reduce the effective dose by 75%–90%.[19,20] Sixty-nine of 170 (40.6%) participants showed the awareness regarding the use of lead apron on regular basis in this study. In other similar studies, the use of lead apron was found to be a low of 13% by Arnout, 31% by Shah *et al.*, 33% by Arnout and Jafar, 32.8% by Srivastava *et al.*, and 46% by Prabhat *et al.* whereas Enabulele and Igbinedion have recorded a high response of 66%.[7-10,13,15]

After the completion of the present study, the study participants were recalled for briefing on radiation safety and radiation protection. It included a lecture on radiation physics, radiation biology, and use of radiation protection barriers. The concept of monitoring the personal exposure and periodic radiation monitoring of the operatory was also spoken about in details. The participants were counseled to adhere to the basic guidelines while advising for a dental radiograph.

Conclusion

From the results obtained from this study, the KAP on radiation protection was higher in dental practitioners, followed by the interns and the least was with the undergraduate student especially the 3rd year students. The principle of radiation protection is to stick to the protocol that will reduce the exposure both to the patient and the operator without compromising the diagnostic information from the radiograph.

Although, the level of awareness decreased from the dental practitioners to the 3rd year students, it can be assumed that their level of awareness will definitely increase as they get more and more clinical exposure.

However, similar studies with reassurance program should be conducted at regular intervals in the social and institutional level to create awareness on radiation safety and radiation protection.

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