



Knowledge on Radiation Protection & Practice among Dental Students

Lingam Amara Swapna^{1*}, Pradeep Koppolu², Bassel Takarji¹,
Sadeq Ali Al-Maweri¹, Nagalaxmi Velpula³, Vani Chappidi³ and Lalitha Ch⁴

¹Department of Oral Sciences and Diagnosis, Al Farabi Colleges, Riyadh, KSA.

²Department of Preventive Dental Sciences, Al Farabi Colleges, Riyadh, KSA.

³Department of Oral Medicine and Radiology, Sri Sai College of Dental Surgery, Vikarabad, India.

⁴Department of Oral Medicine and Radiology, Malla Reddy Dental College for Women, Hyderabad, India.

Authors' contributions

This work was carried out in collaboration between all authors. Authors LAS, PK and BT designed the study, wrote the protocol and the first draft of the manuscript. Authors SAA, NV, VC and LC managed the literature searches. All authors read and approved the final manuscript

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ABSTRACT

Background: It is a known fact that ionizing radiation has various biological harmful effects. Dentists routinely depend on radiographs in their clinical practice for diagnosis, treatment and follow-up of lesions. So, the dentists should be aware of different radiation protection techniques to minimize the radiation and its after effects.

Objective: To assess knowledge, attitude and practice (KAP) of undergraduate dental students towards biological hazards of dental x- ray and appropriate radiographic protection techniques. To compare the KAP between the clinical undergraduate students and interns.

Materials and Methods: Participants comprised of 256 clinical undergraduates (3rd and 4th year Bachelor of Dental Surgery (B. D. S.) students and interns. The data was collected from each

*Corresponding author: E-mail: Laswapna123@gmail.com;

participant by a questionnaire (25 in number) containing multiple choices in the proforma.

Statistical Analysis: Pearson chi-square test was done to evaluate the statistical significance.

Results: Around 59% of the students believed that Dental x-rays were harmful and almost even 10% of the participants didn't have any idea if the dental x-rays were harmful or not. About 65% of the participants were not aware of National Council on Radiation Protection and Measurements (NCRP)/ International Commission on Radiological Protection (ICRP) recommendations on radiation protection. 42% of the participants think that it is an absolute contraindication for pregnant patients to be radiographed. Over all correct response was 70% and it was noted in descending order from interns followed by fourth year and third year students.

Conclusion: The results from the present work show that KAP levels of the dental students regarding the biological effects of x-rays and the different protective measures were low to medium. To improve their working efficiency with safety in dental imaging, continual education programs at regular intervals at institutional level and national level are advised for strict observance of various radiographic protection guidelines.

Keywords: Radioprotection; radiation safety; radiation guidelines; hazards; dosimetry.

1. INTRODUCTION

Radiation is the transmission of energy through space and matter. It may occur in particulate or in electromagnetic radiation. Electromagnetic radiation is the movement of energy through space as a combination of electric and magnetic fields. It is generated when the velocity of an electrically charged particle is altered. Y-rays, x-rays, U.V. rays, visible light, infrared radiation, microwaves and radio waves are all examples of electromagnetic radiation. The types of radiation in the electromagnetic spectrum may be ionizing or nonionizing, depending on their energy [1-5].

The fact that ionizing radiation has various biological harmful effects, by the production of free radicals thus affecting the cell directly or indirectly, leading to DNA damage, including single or double-strand breaks, and or DNA cross-links. X-radiations are detrimental to cells of the human body and are adequately powerful and lead to cancer, leukemia and even genetic damage [1,2]. Radiology has become a major field in diagnostic application in both medicine and dentistry. Radiographs play a critical diagnostic role in dentistry. This field has grown enormously with the rapidly expanding range of imaging modalities like Cone Beam Computed Tomography (CBCT) Computed Tomography (CT), ortho cubic super-high resolution CT (Ortho-CT) for studying different dental pathologies [1,5].

Biological effects of radiation are broadly classified into: Non-stochastic (deterministic) and stochastic effects. Deterministic effects are dose dependent, above which the biological damage appears in the body and the severity of the

response is proportional to the dose. Stochastic effect doesn't have a threshold dose that could lead to biological injury, so the probability of occurrence of the change, rather than its severity, is dose dependent [3,4]. High-dose ionizing radiation (x-ray) causes both deterministic and stochastic effects. Whereas low dose of radiation leads to mainly stochastic effects. Both dentist and patients are at high risk of stochastic effects. Though the exposure is minimal still it is very important to reduce the radiation to avoid the accumulated dose to the dentist and patients in their lifetime [5]. Considering this, dental radiograph should be taken for a patient only when the benefit outweighs the risk of damage from x-radiation. Recognizing the harmful effects of radiation and the risks involved with its use led the National Council on Radiation Protection and Measurements (NCRP) and the International Commission on Radiological Protection (ICRP) to create guidelines for restrictions on the amount of radiation received by both professionally exposed individuals and the general public [5].

The current occupational exposure limits have been established to ensure that no individuals will have deterministic effects and that the probability for stochastic effects is as low as reasonably and economically feasible [5].

There are three guiding principles in radiation protection; The first is the principle of justification. In making dental radiographs this principle obligates the dentist to do more good than harm. The second guiding rule is the principle of optimization. This principle holds that dentists should use every means to reduce unnecessary exposure to their patient and

themselves. This philosophy of radiation protection is often referred to as the principle of ALARA (As low as reasonably achievable). The third principle is that of dose limitation. Dose limits are used for occupational and public exposures to ensure that no individuals are exposed to unacceptably high doses [1-5].

Radiation protection is the science and art of protecting people and the environment from the harmful effects of ionizing radiation. It is also described as all activities directed towards minimizing radiation exposure of patients and personnel during x-ray exposure [2,6]. The amount of exposure received by a patient or operator from dental radiography depends on the film speed, exposure parameters of collimation, technique, and protecting barriers used [2,4]. This demands the operator to have detailed knowledge towards radiation hazards and its protection procedures. Previous literature documented insufficient knowledge among medical students, doctors, paramedics and dentists about their understanding of ionizing radiation or the use of equipment involved in the imaging [7,8]. Thus a need arises to assess the knowledge, attitude and practice (KAP) of dental imaging and appropriate radiographic protection among Indian dental students. In the present study, the clinical years 3rd and 4th of BDS (Bachelor of dental surgery) students and the interns (house surgeons) were selected as they are more prone to radiation risks because of their little knowledge on radiation effects.

2. MATERIALS AND METHODS

The study sample comprises of 256 clinical undergraduates (3rd and 4th year B.D.S) and interns of Sri Sai College of Dental Surgery, Vikarabad, Telangana, India. The questions were asked in the form of multiple choices distributed to each participant and the filled forms were collected from the students after half an hour. The participants received instructions on how to fill the questionnaire, and that answering of all the questions was compulsory. The assessment of content rationality in the questionnaire was related to the views expressed by a group of 5 academicians working in different institutions in addition to their experiences in own dental clinic setups. The institutional ethical committee approval was obtained for the study design and the questionnaire. A written informed consent was obtained from all those who were willing to participate in the survey. Prior to the data collection the questions were pre-tested among a group of 20 professionals in order to

ensure the level of validity and degree of repeatability. The participants were further grouped according to their gender (167 female and 89 male), level of educational qualification (3rd B.D.S, 4th B.D.S and interns). The data was analyzed using SPSS version 17.0 software (SPSS Inc., Chicago, Illinois USA). Descriptive statistics were obtained and frequency distribution and means standard deviation were calculated for awareness on radiation protection and practice among dental students. Pearson Chi-square was used as test of significance for statistical evaluation of means.

3. RESULTS

A total of 256 students were included in the study, out of which 90 students were from 3rd B.D.S, 86 were from 4th B.D.S, and 80 students were interns. Classification of the participants based on gender showed a predominance of female participants a total of 167 (65%) and males were 89 (35%) with higher percentage of males was noticed in interns (Graph 1).

The evaluation of the response to questionnaire among the 256 participants showed 70% correct responses. There was no significant statistical difference between the answers obtained from the 3 groups. Around 59% of the students believed that dental x-rays are harmful and almost 10% of the participants don't have any idea whether the dental x-rays were harmful or not (Table 1). About 65% of the participants answered that they were not aware of NCRP/ICRP recommendations on radiation protection. Nearly 68% of the interns stated that they were aware of radiation hazard symbol, whereas only 36% of 3rd yr students were aware of radiation hazard sign board. Almost 61% of the interns were having knowledge that Long Focal Spot Film Distance (FSFD) reduces the tissue volume exposure of the patient, showing a significant statistical difference of the knowledge when compared to 3rd yr and 4th yr students.

There was a significant difference statistically ($p \leq 0.04$) among the participants with respect to the awareness of deterministic effects & stochastic effects. Almost 64% of internship students have stated that paralleling angle technique gives more accurate image and lowers the exposure dose to thyroid gland and lens of eye showing a significant statistical difference ($p \leq 0.045$) compared to 3rd yr and 4th yr students. With regard to the question "personal monitoring devices to be worn, above or below the lead

apron”, the participants had a varied view, but majority answered that it should be worn above the lead apron. For the question “indicate the reason for not using lead apron regularly”, maximum participants declared that they follow

position distance rule .The participants showed a significant difference ($p \leq 0.04$) with their response to choose the correct option regarding the position-distance rule of (6 feet at 90° to 135°) (Table 1).

Table 1. Response of the Participants for the questionnaire

Sl. no	Question		3 rd year (n=90)	4 th year (n=86)	Interns (n=80)	p-value
1	Are Dental X-rays harmful?	Yes	50	48	53	0.039*
		No	30	30	19	
		Don't know	10	8	8	
2	Can X-rays be reflected from the walls of room?	Yes	28	24	21	0.044*
		No	10	53	49	
		Don't know	52	9	10	
3	Are you aware of NCRP/ICRP (National council on radiation protection and measurement/International commission on radiological) recommendations ?	Yes	25	30	35	0.97
		No	65	56	45	
4	Are you aware of the radiation hazard symbol?	Yes	32	52	54	0.98
		No	58	34	26	
5	Are you aware of usefulness of collimators and filters in dental radiography?	Yes	26	48	56	0.97
		No	64	38	24	
6	Does Rectangular collimator help in reducing the patient's exposure?	Yes	38	46	42	0.06
		No	52	40	38	
7	Does Long Focal spot film distance (FSFD) reduce the tissue volume exposure of the patient?	Yes	40	45	49	0.04*
		No	50	41	31	
8	Are you aware of deterministic effects & stochastic effects?	Yes	35	40	52	0.04*
		No	55	46	28	
9	Are you aware of ALARA principle?	Yes	39	49	52	0.97
		No	51	37	28	
10	Does digital radiography require less exposure than conventional radiography?	Yes	35	52	54	0.091
		No	45	20	20	
		Don't know	10	14	6	
11	Do high speed films reduce patient exposure?	Yes	38	35	43	0.06
		No	52	51	37	
12	Do you prefer to hold the films with your hand during exposure?	Yes	10	15	16	0.98
		No	80	71	64	
13	Will you ask the patient to hold the film with their hand during exposure?	Yes	70	71	68	0.91
		No	20	15	12	
14	Are you confident in using X-film holding devices for taking intraoral radiographs on patients?	Yes	9	17	19	0.92
		No	81	69	61	
15	Dental radiographs are absolutely contraindicated in pregnant patients?	Yes	3	46	26	0.98
		No	45	27	35	
		Don't know	10	13	19	
16	Will you adhere to radiation protection protocol at the time of your future private clinical practice?	Yes	45	47	30	0.076
		No	32	29	29	
		Don't know	13	10	21	

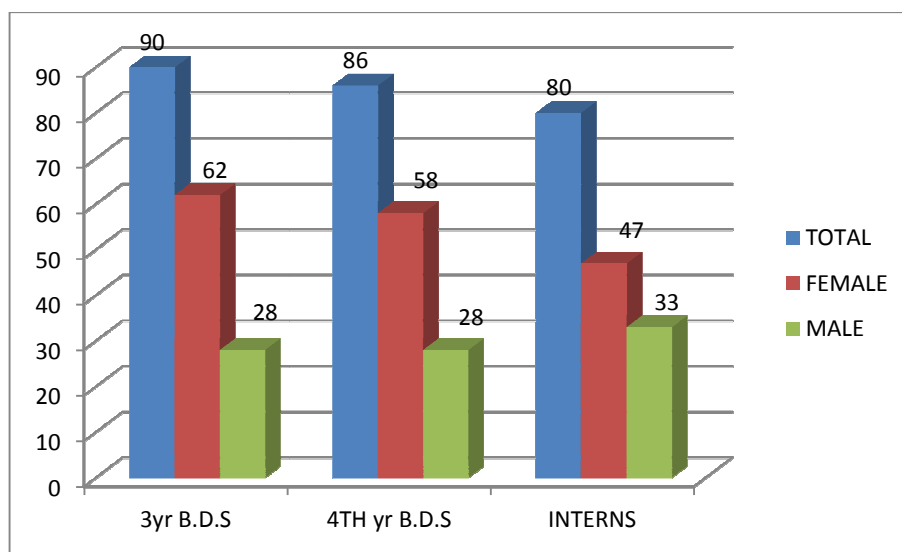
Sl. no	Question		3 rd year (n=90)	4 th year (n=86)	Interns (n=80)	p-value
17	Does paralleling angle technique gives more accurate image and lowers the exposure dose to thyroid gland and lens of eye.	Yes	39	46	51	0.045*
		No	51	40	29	
18	Do you prefer to regularly use lead Aprons?	Yes	38	28	24	0.45
		No	52	58	56	
19	Should repetition of x-ray film/exposure be minimized for the patient?	Yes	45	47	31	0.54
		No	30	28	28	
		Don't know	15	11	21	
20	Should drifting of the x-ray tube or patient should be avoided during exposure?	Yes	52	58	56	0.07
		No	38	28	24	
21	Are you aware of (Atomic Energy Regulatory Board) AERB guidelines for Radiation exposure room shielding?	Yes	35	46	26	0.064
		No	55	40	54	
22	Personal monitoring badges should be worn by the operator?	a) Above the lead apron	30	37	38	0.13
		b) Below the lead apron	20	22	26	
		c) Doesn't matter.	25	27	6	
23	Indicate why- you are not using lead apron regularly?	a) Non- availability of apron	15	13	8	0.37
		b) Due to weight of the apron	30	20	18	
		c) Common apron for all	5	28	15	
		d) Will follow Position distance rule	40	25	39	
24	The ideal distance an operator should stand (position distance rule) while performing dental radiographic exposure is	a) 4 feet and 90 ⁰ -135 ⁰	15	13	18	0.042*
		b) 4 feet and 60 ⁰ -90 ⁰	25	22	15	
		c) 6 feet and 90 ⁰ -135 ⁰	28	28	27	
		d) 6 feet and 60 ⁰ -90 ⁰	22	23	20	
25	If you are "not adhering" to radiation protection protocol in your private practice in future, pick a reason from below?	a) Depends on space availability.	15	15	18	0.926
		b) Because of financial reasons.	20	25	20	
		c) Private clinical setup has less radiation exposure hence it does not require stringent protection measures.	33	25	20	
		d) Others	22	21	22	

(*P value <0.05, significant)

4. DISCUSSION

Despite the various applications of radiation in medical field, it can be hazardous if not handled cautiously. A watchful balance between the profit of enhancing human health, and the risks related

to the radiation exposure of radiographers, patients and the public, has to be taken care in the practice of diagnostic and interventional radiation. Though radiation exposure in dentistry is minimal, it is very important to follow the guidelines to minimize the radiation exposure.



Graph 1. Demographic data of the participants

The aim of the radiation protection protocol should also focus on avoiding the occurrence of deterministic effects and to decrease the possibility of stochastic effects by reducing the exposure to the dental personnel and the patients in dental office [1,9,10].

To achieve these goals, the dental students who are the future dentists, should have a detailed awareness about the biological hazards of x-rays and the precautions required to be followed to prevent unnecessary radiation exposure. Bearing this in mind, we have selected the 3rd yr, 4th yr B.D.S students and interns to know their level of knowledge and awareness on dental x-rays. A structured questionnaire with majority of close-ended questions were framed to obtain precise response in relevance to knowledge, and to know the attitude and practice of these students a leading question was suggested. The results showed that majority of the students in the study had the knowledge of harmful effects of dental radiation and they agreed that utmost care should be taken while handling diagnostic imaging in dental setup. For the question "Can x-rays be reflected from the walls of room?" there was a significant statistical variance among the 3 groups, with ($P \leq 0.04$), and there was a consistent difference observed with the knowledge amongst 3rd yrs, 4th yrs and the interns suggesting of less clinical experience and basic understanding of radiation physics among 3rd yrs. These results were in accordance with the previous study done on dental clinical and pre-clinical students, where 46% of students

opted that x-rays cannot be reflected, [10] in our study it was about 43% students who agreed that x-rays cannot be reflected. In our study 42% of the participants think that it is an absolute contraindication for pregnant patients to be radiographed, whereas in a study done by Arnout et al, 46% of students assume that it is absolute contraindication to take radiograph for a pregnant patient [10]. In a similar study conducted by Razi et al the study population of dentists was found not to have adequate knowledge regarding the diagnostic dental imaging during pregnancy and the associated risks [11]. For the question, "Will you adhere to radiation protection protocol at the time of your future private clinical practice" 48% of the participants stated that they would strictly adhere to the protocol, others were not very sure of following the protection measures in future practice because of various reasons like space availability, financial reasons etc. In contrast 80% of the students in a study conducted by Prabhat et al agreed to adhere to the radiation protection protocol in their future private practice [3].

With the obtained results in our study, it is arguable to determine whether these future dentists were having adequate knowledge about the radiation protection protocols. However, additional research with a bigger sample size involving various other institutions is required to authenticate our results. After the completion of the study, we advised all the participants to update their knowledge on radiation protection protocol by attending seminar in our institution and also encouraged them to update their

understanding of the equipment by taking a hands on course and demonstration in our department which focused to empower the students with all the necessary understanding of the NCRP, ICRP guidelines and personnel monitoring devices [12,13].

5. CONCLUSION

The results, obtained at the present work, indicates that the KAP level of the dental students regarding the biological effects of x-rays, the different protective measures and their practice to adhere to strict protection protocol was low to medium. This could be because of the curricular grade of the graduation course, and syllabus. To help them in minimizing the exposure to the dental fraternity or patients with focus on welfare of the patients we emphasize continual education programs at regular intervals at institutional level and national level for strict observance of various radiographic protection guidelines.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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