



KNOWLEDGE, ATTITUDE AND PRACTICE OF DENTISTS TOWARD ORAL RADIOLOGY AND RADIATION PROTECTION

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ABSTRACT Radiology is a diagnostic test, in which ionization radiation is used in dentistry. This necessitates that oral and maxillofacial radiology needs to be done and conscientiously and with utmost care. In dentistry, radiographs are helpful in detecting oral diseases and bone related problems. The operators of radiographic machines were protected with a lead apron, low leaded flaps, and were leaded in all the processes. The objective of this work is to analyze dentists' knowledge, attitude and practice towards oral radiology, radiation hazard to patients and protection of patients from radiation in Taif City, KSA. A cross-sectional descriptive study was conducted at several government and private dental clinics in Taif City, KSA. 78 dentists were randomly selected from October 2017 to April 2018. Of the 65% private clinics and 34% government hospitals, 42.3% of the X-rays in the private dental clinics were done by nurses while only 10.3% was done by X-ray technologist and 47.4%, dentists. The results obtained showed that the dentists' and X-ray technologists' levels of knowledge of radiology were very good, with 97.4% and 75% dentists having poor practice and attitude toward protection from radiation, while the X-ray technologists' attitude was considered good (100%). Finally, it is recommended that the level of awareness among Taif Community be elevated to prevent radiation risk in dental clinics.

KEYWORDS : Knowledge, Attitude, Radiation, Protection, Dentist.

INTRODUCTION:

The human teeth are not just for fancy, rather they have a vital part to play in our nutrition and well-being generally. Teeth enable us to have good food and be well sustained. There is need to minimize the radiation dose given to patients but maximize the diagnostic benefit. Now, dentists can choose from diverse kinds of imaging modalities available. Periapical, bitewing, or panoramic radiography can be the correct method needed to end the confusion faced in diagnosis in the practice of dentistry and might assist to diagnose a patient's ailment.^[1]

Though dental radiography has been greatly beneficial in the diagnosis of patients' diseases, the high active dosages, mostly from cone beam computed tomography (CBCT) investigations, are too enormous that there is a need to look for a way to reduce the rate at which patients are exposed to it. The use of digital sensors or F-speed film in lieu of D-speed film, plus rectangular collimation instead of round collimation can enable dentists to decrease the exposure of patients to bitewing and full-mouth radiographs by a factor of 10. It is really important in health practice to justify and optimize an operation plus limited dosages. It is wise to create a standard level of diagnosis for dental radiography in Japan. Also, dentists need to be updated always about safety and new equipment available, provisions and methods that can enhance the power of radiographs diagnosis and reduce patients' exposure to radiation.^[4] When patients are X-rayed, millions of photons go through

their bodies. This process can cause ionization to destroy any molecule, but the greatest harm that can be done is that of the DNA in the chromosomes. A lot of DNA damage can be mended instantly, but it is very hard for a part of a chromosome to be changed permanently. This can result in a tumor. The dormant period between when a patient is exposed to X-rays and when a tumor is diagnosed medically can take a lot of years. The risk that a specific X-ray dosage can produce a tumor can be predicted. Thus, it is necessary to know the doses that radiological systems receive. Though there are small doses and risks for dental radiology, many studies on epidemiology have proved that there are high risks of the brain^[5,6], salivary gland^[7,6] and thyroid^[8,9] tumors for dental radiography. Dentists' oversight of the clinical team is very crucial to have effective and safe mouth care. Normal regular practices like extractions of the tooth, preparation, and placement of fillings or applying of anesthetics can potentially cause risky problems like infection, temporary or even permanent nerve damage, protracted bleeding, hematomas and ache.^[10] In this work, the operators were protected with a lead apron, low leaded flaps, and leaded glass (0.5 mm leaded-equivalent for each) in all the operations. Standard protective procedures, like staying very far from the source of the X-ray (inverse square law) and minimizing the field view were followed in all cases.^[11] Rouwan et al. 2016^[12] noted that radiation is the energy that moves through space and matter, whose sources can be natural "external or internal" or artificial^[12]; they help in medical and dental radiography.^[13]

Radiographs are used to detect mouth infections, cavities, problems connected to bones, planning of treatment and follow-up after treatments in dentistry.^[14] A conventional method like intraoral, extraoral and occlusal radiography or a particular imaging method like tomography, CT scan, and MRI can be used for oral and maxillofacial radiographic imaging.^[15]

Regardless of the type of X-rays used, problems arise due to their misuse and these are majorly directed to the patients. These harmful biologic changes can either affect the human cells by directly striking the cells and alter the structure and function of the affected molecules or indirectly by forming free radicals which react with other free radicals. This, in turn, results in the formation of hydrogen peroxide which can break down large molecules such as proteins and DNA and cause cell damage.^[16] In an office study done for official publications of the European Communities (2004)^[17], a practical guide was provided to protect expert groups of dentists and their assistants from radiation, using two relevant councils. There is no one exposed to X-rays that can be said to be totally exempted from risk, so there must be correct safety and protection measures in place for dentists and their assistants when exposed to radiation.^[17] Svenson et al. 1996^[18] did a study titled, 'developing a technique to measure the attitudes of dentists towards radiation hazards.' They described their prevalence among general dental practitioners in Sweden. A questionnaire was sent to 2000 dentists selected randomly who are registered in the list of the Swedish Dental Society. They obtained a response rate of 69.3% and constructed an index for measuring attitudes towards radiation hazards.^[18] Aravind et al. 2016^[19] evaluated general dental practitioners' level of awareness and attitude towards radiation hazards and safety practices in Trivandrum District, Kerala, India.^[19] Alexander 2015^[20] investigated the perceptions of the dental community practicing in the UAE about radiology and its toxic impacts.^[20] Eman (2014)^[21] assessed the knowledge, attitude and perceptions of Egyptian dental students, interns and dentists towards biological hazards of dental X-ray and right protection from radiography. To make a comparison of KAP among undergraduate, interns and postgraduate students.^[21] This study aims to evaluate the knowledge, attitude, and practice of dentists towards oral radiology, the hazard of radiation to patients and protection of patients from radiation in Taif City, Saudi Arabia.

MATERIALS AND METHODS:

Study design and area This is a cross-sectional study used to evaluate the knowledge, attitude and practice of dentists toward oral radiology and protection from radiation. The study was conducted at several government hospitals and private clinics in Taif City, KSA.

Sample size and duration of the study:

78 dentists (both government and private ones) were randomly selected to participate in this study, from October 2017 to April 2018.

Data collection tools:

A well – structured administered questionnaire consisting of three parts as follows was used for the data collection.

First part: is concerned with the demographic characteristics of the patients: their age, gender, nationality, marital status, and years of work experience),

Second part: is concerned with the knowledge of the dentists about protection from radiation; it had a total of 12 items. These items explore knowledge of radiation hazard, stochastic effects, radiation dose and other protection from radiation protocols.

Third part: The attitude and practice domain of the questionnaire is composed of a total of 5 items. These items explored the dentists' attitude towards prescription of radiographs, asking of female patients about the ten-day rule, usage of thyroid shield for patients, standing behind a barrier when exposed to radiation, usage of film holding devices and checking of the radiograph machine regularly.

Data Analysis:

Statistical package for social sciences program (SPSS) version 20 was used to analyze the data. The results are presented in tables and graphs.

Ethical consideration:

The consent of all the participants were sought orally to fill in the questionnaire and participate in the study. They were informed that

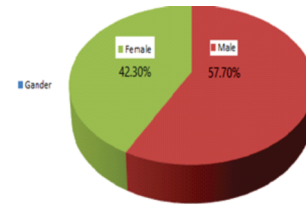
none of their private information would be published. Official approval was obtained before the study was conducted.

RESULTS:

Table (1): Distribution of the age groups of the study sample. (n=78)

Age	Frequency	Percent	Cumulative Percent
21-30y	18	23.1	23.1
31-45y	44	56.4	79.5
46-55y	16	20.5	100.0
Total	78	100.0	

Fig(1): Distribution of the study sample based on gender (n=78)



Fig(2): Distribution of government and private dental clinics. (n=78)

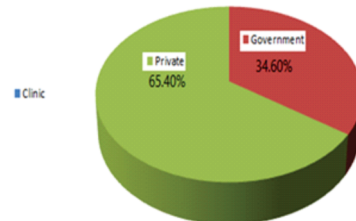


Fig (3): Marital status distribution of the participants (n=78).

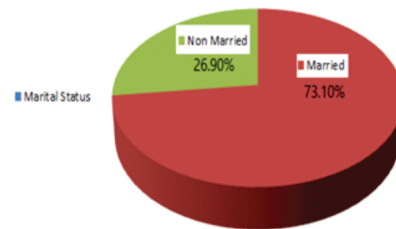


Fig (4): Years of work experience distribution of the participants (n=78)

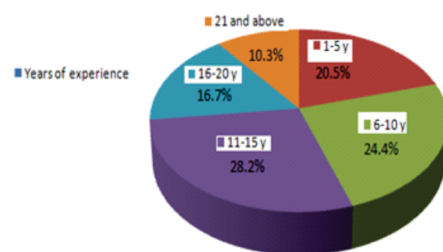


Fig (5): Dental X-rays done inside the clinic (n=78)

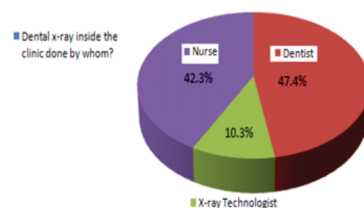


Table (2): Distribution of the knowledge questions of the participants (n=78)

Knowledge questions	Number	%
1. Are you aware of radiation hazards?		
Yes	76	97.4
No	2	2.6
2. Do you know that digital radiography requires less exposure than conventional radiography?		
Yes	74	94.9
No	4	5.1
3. Do you know the effective dose estimate range?		
Yes	52	66.7
No	26	33.3
4. Are you aware of stochastic effects of radiation?		
Yes	61	78.2
No	17	21.8
5. Do you know X-ray can be reflected from the walls of the room?		
Yes	71	91.0
No	7	9.0
6. Do you know that high-speed films reduce exposure?		
Yes	66	84.6
No	12	15.4
7. Do you know the ideal distance an operator should stand while exposed to dental radiographic system?		
Yes	79.5	62
No	20.5	16
8. Do you know that X-ray is contraindicated for pregnant women?		
Yes	94.9	74
No	5.1	4
9. Are you satisfied with the protection level in your workplace?		
Yes	74.4	58
No	25.6	20
10. Do you know the ICRP protection protocol?		
Yes	3.8	3
No	96.2	75
11. Do you know which of the following radiographic techniques deliver more radiation to patients?		
Pantomograph	35.9	28
Full mouth periapical	64.1	50
12. What is the most important organ that needs to be protected from radiation in dental radiography?		
Gonad	3.8	3
Thyroid	88.5	69
Bone marrow	3.8	3

Table (3): Attitude questions given to the study sample (n=78)

Attitude questions	Number	%
1. Do you ask the female patients about the ten-day rule?		
Yes	43	55.1
No	35	44.9
2. Do you stand behind a protective barrier during exposure?		
Yes	63	80.8
No	15	19.2
3. Do you use lead apron and thyroid shield for patients' protection daily?		
Yes	42	53.8
No	36	46.2
4. Do you prefer to let the patient hold the film by its handle?		
Yes	58	74.4
No	20	25.6
5. Do you wear TLD badge daily ?		
Yes	12	15.4
No	66	84.6
6. Do you check radiographic machine regularly?		
Yes	75	96.2
No	3	3.8
*If yes, how often?		
Every month	37	47.4
Year	20	25.6
More	18	23.1

Table (4): Relation between Clinic * dental X-rays done inside the clinic (n=78)

Persons that do dental X-ray inside the clinic?	Clinic		Total	Exact Sig. (1-sided)
	Government	Private		
Dentist	8 (21.6%)	29(78.3%)	37	0.071
X-ray Technologist	6 (75%)	2(25%)	8	
Nurse	13(39.3%)	20(60.6%)	33	
Total	27	51	78	

Table (5): Relation between Clinic and wearing of TLD badges daily (n=78)

Clinic	Do you wear TLD badges daily?		Total	Exact Sig. (1-sided)
	Yes	No		
Government	10 (37.0%)	17 (62.9%)	27	0.00
Private	2 (3.9%)	49 (96.0%)	51	
Total	12 (15.3%)	66 (84.6%)	78	

Table (6): Relation between marital status and wearing of TLD badges daily (n=78)

Marital status	Do you wear TLD badges daily?		Total	Exact Sig. (1-sided)
	Yes	No		
Married	6 (10.5%)	51 (89.4%)	57	0.05
Non Married	6 (28.5%)	15 (71.4%)	21	
Total	12 (15.3%)	66 (84.6%)	78	

Table (7): Relation between years of work experience and being aware of radiation hazards (n=78).

Years of work experience	Are you aware of radiation hazards?		Total	Asymp. Sig. (2-sided)
	Yes	No		
1-5 y	14 (87.5%)	2 (12.5%)	16	0.05
6-10 y	19 (100%)	0 (0%)	19	
11-15 y	22 (100%)	0 (0%)	22	0.04
16-20 y	13 (100%)	0 (0%)	13	
21 and above	8 (100%)	0 (0%)	8	
Total	76 (97.4%)	2 (2.5%)	78	

Table (8): Relation between years of work experience and knowing the perfect distance between an operator and dental radiographic system (n=78).

Years of work experience	Do you know the ideal distance an operator should stand while being exposed to dental radiographic system?		Total	Asymp. Sig. (2-sided)
	Yes	No		
1-5 y	9 (56.25%)	7 (43.75%)	16	0.05
6-10 y	16 (84.21%)	3 (15.7%)	19	
11-15 y	18 (81.81%)	4 (18.18%)	22	0.04
16-20 y	13 (100%)	0 (0%)	13	
21 and above	6 (75%)	2 (25%)	8	
Total	62 (79.4%)	16 (20.5%)	78	

Table (9): Relation between years of work experience and the most important organs that must be protected during dental radiography (n=78)

Years of work experience	What is the most important organ that needs to be protected from radiation in dental radiography?				Total	Asymp. Sig. (2-sided)
	Gonad	Thyroid	Bone Marrow	Skin		
1-5 y	0 (0%)	14 (87.5%)	2 (12.5%)	0 (0%)	16	0.09
6-10 y	1 (5.2%)	16 (84.2%)	0 (0%)	2 (10.5%)	19	
11-15 y	0 (0%)	21 (95.4%)	1 (4.5%)	0 (0%)	22	0.04
16-20 y	0 (0%)	12 (92.3%)	0 (0%)	1 (7.6%)	13	
21 and above	2 (25%)	6 (75%)	0 (0%)	0 (0%)	8	
Total	3 (3.84%)	69 (88.4%)	3 (3.8%)	3 (3.8%)	78	

Table (10): Relation between years of work experience and asking female patients about the ten-day rule (n=78)

Years of work experience	Do you ask female patients about the ten-day rule?		Total	Asymp. Sig. (2-sided)
	Yes	No		
1-5 y	8 (50%)	8 (50%)	16	0.005

6-10 y	6 (31.5 %)	13 (68.4%)	19	0.006
11-15 y	11 (50%)	11 (50 %)	22	
16-20 y	11 (84.6%)	2 (15.3 %)	13	
21 and above	7 (87.5%)	1 (12.5 %)	8	
Total	43 (55.1 %)	35 (44.8 %)	78	

Table (11): Relation between years of work experience and using of lead apron and thyroid shield for patients' protection daily (n=78)

Years of work experience	Do you use lead apron and thyroid shield for patients' protection daily?		Total	Asymp. Sig. (2-sided)
	Yes	No		
1-5 y	8 (50%)	8 (50 %)	16	0.07
6-10 y	7 (36.8 %)	12 (63.1 %)	19	0.09
11-15 y	13 (59.0 %)	9 (40.9%)	22	
16-20 y	7 (53.8%)	6 (46.1 %)	13	
21 and above	7 (87.5%)	1 (12.5 %)	8	
Total	42 (53.8 %)	36 (46.1%)	78	

Table (12): Relation between dental X-ray done inside the clinic and knowing the perfect distance between an operator and the dental radiographic machine (n=78)

Persons that do dental X-ray done inside the clinic	Do you know the ideal distance an operator should stay from the dental radiographic machine?		Total	Asymp. Sig. (2-sided)
	Yes	No		
Dentist	25 (67.5%)	12 (32.4%)	37	0.03
X-ray Technologist	8 (100 %)	0 (0%)	8	0.03
Nurse	29 (87.8 %)	4 (12.1 %)	33	
Total	62 (79.4 %)	16 (20.5%)	78	

Table (13): Relation between dental X-ray done inside the clinic done and asking female patients about the ten-day rule (n=78)

Persons that do dental X-ray inside the clinic	Do you ask female patients about the ten-day rule?		Total	Asymp. Sig. (2-sided)
	Yes	No		
Dentists	24 (64.8%)	13 (35.1%)	37	0.03
X-ray Technologists	6 (75 %)	2 (25%)	8	
Nurses	13 (39.3 %)	20 (60.6%)	33	
Total	43 (55.1%)	35 (44.8%)	78	

Table (14): Relation between knowing that digital radiography requires less exposure than conventional radiography and staying behind a protective barrier during exposure (n=78)

Do you know that digital radiography requires less exposure than conventional radiography?	Would you stand behind a protective barrier during exposure?		Total	Exact Sig. (1-sided)
	Yes	No		
Yes	62 (83.7 %)	12 (16.2%)	74	0.003
No	1 (25%)	3 (75 %)	4	0.00
Total	63 (80.7%)	15 (19.2)	78	

Table (15): Relation between knowing the effective dose estimate range and checking radiographic machine regularly (n=78)

Do you know the effective dose estimate range?	Do you check the radiographic machines regularly?		Total	Exact Sig. (1-sided)
	Yes	No		
Yes	52 (100)	0 (0)	52	0.01
No	23 (88.4)	3 (11.5)	26	0.01
	75 (96.1)	3 (3.8)	78	
If yes, how often?			Total	Exact Sig. (1-sided)
Every Month	Year	More		
30 (57.6 %)	14 (26.9 %)	8 (15.3%)	52	0.006
7 (30.4 %)	6 (26.0 %)	10 (43.4%)	23	0.008
37 (49.3%)	20 (26.6%)	18 (24%)	75	

Table (16): Relation between being aware of stochastic effects of radiation and standing behind a protective barrier during exposure (n=78)

Are you aware of stochastic effects of radiation?	Do you stand behind a protective barrier during exposure?		Total	Exact Sig. (1-sided)
	Yes	No		
Yes	53 (86.8 %)	8 (13.1%)	61	0.009
No	10 (58.8%)	7 (41.1 %)	17	0.009
Total	63 (80.7%)	15 (19.2%)	78	

Table (17): Relation between knowing X-ray can be reflected from the walls of the room and standing behind a protective barrier during exposure (n=78)

Do you know X-ray can be reflected from the walls of the room?	Do you stand behind a protective barrier during exposure?		Total	Exact Sig. (1-sided)
	Yes	No		
Yes	60 (84.5%)	11 (15.4 %)	71	0.007
No	3 (42.8 %)	4 (57.1 %)	7	0.007
Total	63 (80.7%)	15 (19.2%)	78	

Table (18): Relation between knowing ICRP protection protocol and wearing of TLD badges daily (n=78)

Do you know the ICRP protection protocol?	Do you wear TLD daily?		Total	Exact Sig. (1-sided)
	Yes	No		
Yes	2 (66.6%)	1 (33.3%)	3	0.01
No	10 (13.3%)	65 (86.6%)	75	0.01
Total	12 (15.3%)	66 (84.6%)	78	

DISCUSSION:

This study aims to evaluate the knowledge, attitude and practice of dentists towards oral radiology hazard and protection of patients from radiation among the study sample in two government dental clinics and 22 private dental clinics in Taif City, from October 2017 to April 2018. In this study, 78 participants answered the questionnaire. 57.70% were males and 42.30% were females (fig 1); 73.10% of them were married; more than half (65.40%) of them were from private clinics and the rest (34.60%), from government hospitals (figs 2&3). Their age ranges from 21-55y. Most of the participants' ages were from 31-45y (56.4%); those between 21-30y were 23.1% and 46-55y were 20.5% (table 1). In the present study, the result indicates that 28.2% of the participants have from 11 to 15 years' work experience and only 10.3% have 21 years' and above work experience. About 47.4% of the dental X-ray examinations were done by the dentists in the clinics (figs 4&5). Regarding the knowledge of the participants, 97.4% have good knowledge of radiation hazards (table2). This is supported by Almas et al.^[22] who reported in their study that 59.6% of the study participants had good knowledge about radiation hazards; and also by Praveen et al.^[23] who reported that all of the dental interns had knowledge of radiation hazards, and can efficiently control and stop hazards caused by radiation. Thus, understanding the impacts of ionization radiation on people's health is very important.^[22]

In relating the dentists' year of qualification and their knowledge base and attitude, it is observed that those who qualified between 1972 and 1991 had relatively better knowledge and awareness, followed better practices and were more directly involved in taking radiographs compared to those who qualified in later years.^[24] Also, we found a significant correlation between awareness and years of work experience among the study sample (P=0.05),(N=78) (table 6). This is supported by the results obtained in Tabriz by Razi et al. (2011), who indicated that an association was found between the dentists' number of years in practice and their awareness about exposure to radiation hazards and protective measures. This is also similar to Prabhat et al.^[25] result. This means that the more the dentists practice their profession the more they acquire knowledge and follow protective measures.

In a Spanish study done by Alcazar et al.^[26], from the statistical analysis, great differences were found between the dosages applied and the kind of procedure utilized; the lowest time of being exposed was calculated in digital systems, that utilized very lower dosages than both manual and automatic systems, and when conventional radiographic films were utilized.^[26] In this study majority of the dentists (94.9%) know that digital radiography requires less exposure time than conventional radiography; in Coorg District, a study done by Asha et

al. (2015) showed that 81.3% of the dentists know about it, and the dosage that is active was between 19 and 368 μSv . The remaining tissues (37%), salivary glands (24%), and thyroid gland (21%) contributed the largest to the active dose. The values measured were great for all the organs as a result of variations in exposure elements, the primary beam's height and diameter, and placement of the beam based on the radiosensitive organs.^[27] This study represents 66.7% of the dentists who know the effective dose estimate range.

Regarding the stochastic effect of radiation, more than three-quarters of the participants (78.2%) (table 2) have a good knowledge about it. A study done in Korea by Lee et al. (2013)^[28] conveyed that only 46% were aware of the deterministic and stochastic impacts of radiation while the rest were unaware of the possible natural hazards of being exposed to X-ray. 46% participants had knowledge of the deterministic and stochastic effects of radiation in a study reported by Rouwan et al. (2016).^[12] Also, they reported that 40.9% knew that X-ray beams cannot be reflected from the walls of a room, but in this study, most of the dentists (91.0%) know that X-ray beam cannot be reflected from the walls of a room.

84.6% of the participants in this study are aware that high-speed film reduces exposure to radiation (table 2). Studies have shown that the following countries reported lower usage of fast film: Spain (0.8%) (Alcaraz et al., 2009)^[29], India (2%) (Math et al., 2014)^[30], and Turkey (10.2%) (Ilgyu et al., 2005).^[31] Conversely, a higher usage was reported in some countries namely, Belgium (40%) (Jacobs et al., 2004).^[32] In these studies, it seems that dentists are more prone to use faster speed film. This could imply that the awareness of using fast film is higher in certain countries due to the quality of education and exposure to optimal radiation practice and availability of different speed films. The improvement of film technology has resulted in the development of faster films. By moving from the D-speed film to the E-speed film, the dose of radiation can be decreased up to half without affecting the quality of the image.

94.9% of the participants in this study are aware of the perfect distance an operator ought to stay away from the dental radiographic source (table 2). Similarly, Yasir et al. (2015)^[33] reported in a study done in Sudan that majority of the dentists (72%) did not have any idea of the minimum distance they should stay away from radiation source. The key factor in being protected from ionization radiation is to maximize the distance from the radiation source as practically as possible. Operators are advised to stay at least two meters from radiation source. It is very important to protect the operators of radiation machine. This work's results show that many of the dentists had no idea about the safe distance from radiation source. This is disturbing in terms of protecting dental practitioners as well as patients from radiation.

94.9% of the participants in this study are aware that X-ray is contraindicated for pregnant women (table 2) (Eman and Ameen, 2014).^[34] A study reported by the findings of this work shows that 42.3% of the 1st group and 27.3% of the 2nd group participants consider it completely dangerous for a pregnant woman to do dental radiographs. In simple terms, around 30-50% of dentists in the future will not attend to pregnant women, irrespective of their pregnancy semester, the emergency level and the diverse safety measures that need to be carried out for them. In line with this present work, a past work was carried out on 250 general dentists. The author's conclusion is that the dentist's population studied appear not to know much about the risk of carrying out dental radiation diagnosis on pregnant women.^[35,36]

3.8% of the participants have awareness of ICPR protection protocol (table 2). At the end of the study, we advised all the participants to have current knowledge of radiation protection protocol by attending seminars in our institution and also encouraged them to update their understanding of the equipment used by taking a course as well as doing practical in our department which focus on empowering the students to understand all the necessary NCRP, ICRP guidelines and personnel monitoring devices.^[37,38] 64.1% of the participants in this study are aware that the following radiographic techniques deliver more radiation to patients, that is the full mouth periapical radiographs (table 2). A set of full mouth periapical radiographs exposes patients to higher radiation dose than panoramic radiograph (White & Pharoah, 2009).^[39] A study done in Iran shows that 46% of the dentists have no idea of this (Shahab et al., 2012).^[40] 88.5% of the participants of this study know that the most important organ that needs to be protected

from radiation in dental radiography is the thyroid (table 2); it is very sensitive to most radiograph located in the head and neck areas (Schonfeld et al., 2011).^[41] In the present study, half of the dentists did not know that the thyroid gland is the most radiosensitive organ. This is similar to the findings obtained in a study done in India (Math et al., 2014)^[30], but high compared to that done in Iran, where 34% of the dentists did not know (Shahab et al., 2012).^[40]

When the participants of this study were asked if they stand behind a protective barrier when exposed to a radiation source, 80.8 % of them said 'yes', while only 19.2% said 'no'(table 3). Our result is confirmed by Aravind et al. (2016) who reported the use of a protective barrier (22%).^[42]

In this study, 53.8% of the dentists used lead apron and thyroid shield to protect patients (table 3). Shahab et al. (2012)^[40] reported that 34% dentists occasionally shield their patients with thyroid shields and lead aprons occasionally. Also, Alexander Luke (2015)^[20] represents that (63.2%) of dental hospitals give lead apron to patients to protect them from radiation. According to Aravind, (2016)^[42] (16%) in a study done, dentists use lead apron. In Rouwan (2016)'s results^[12] only 20.7% used lead aprons on a regular basis which was almost similar to that obtained by Roja et al. (2017)^[43] where only 12% of the dentists used lead apron while operating an X-ray unit. Though not significant, the number of participants not wearing lead aprons is due to the overall likelihood that they are not really that exposed to dental X-ray machine, hence less number of dentists use lead apron and thyroid collar.

The dentists in this work prefer to let the patients hold the film by its handle (74%) (table 3). In this study, 57% did not use film holders and beam aiming devices. Salti et al. (2002)^[44] and Shahab et al. (2012)^[40] reported that 45% of the dental practitioners used film holders, while Aravind et al. (2016)^[42] reported that 70.9% of the practitioners asked the patients to hold the intraoral periapical film when exposed to X-ray. Roja et al. (2017)^[43] said that majority of the dental practitioners (75%) were not using film holders while about 25% were using film holders. But, 50% of the dental practitioners asked their patients to hold the films inside their mouths with their fingers almost every time they were exposed to radiation.

Regarding the dentists' attitude towards wearing of TLD badges daily in this study, 15.4% of them wear TLD badges daily (table 3). From the study of Aravind (2016)^[42], 90% of the dentists know TLD badge, but only 2% use it in their practice daily. In a report given by Roja et al. (2017)^[43], among the participants, 10% dental practitioners, 25% dental students, and 87% radiographers use TLD badges.

In this study, 47.4% of the dentists check their radiographic machine every month while 25.6% and 23.1% do that yearly (table 3). Shahab et al. (2012)^[40] reported in their study that 43% of the dental practitioners checked their X-ray machines regularly.

There was a significant correlation between the type of clinic and the dentists who wear TLD badges daily among the study sample ($P=0.00$) ($n=78$) (table 4). This is contrary to the study of Ashu (2016)^[45], who reported that there was no significant correlation between the type of hospital and awareness of the adverse effect of radiation.

There was a significant correlation between years of work experience and the dentist who wear TLD badges daily among the study sample ($P=0.05$) ($n=78$) (table 6). This is in line with Razi et al. (2011)^[35] who indicated in their study that a correlation was found between the number of years in practice and awareness of exposure to hazards and protective measures in many of the questions asked the participants. This is similar to Prabhat et al. (2011)'s^[25] result.

There was a significant correlation between years of work experience and the dentists who know the perfect distance that should be between an operator and dental radiographic machines among the study sample ($p=0.05$) ($n=78$) (table 7). This is similar to a study reported by Almas (2016)^[22], where a great relationship was found between practices and years of work experience ($P=0.05$).

There was a significant correlation between years of work experience and the dentists who know the most important organ that needs to be protected from radiation in dental radiography among the study sample ($p=0.09$) ($n=78$) (table 8). Moreover, the results obtained by

Razi et al. (2011)^[35] indicated that there was a relationship between the number of years in practice and the awareness about exposure to hazards and protective measures in majority of the questions asked the study participants. This is similar to the result of Prabhat et al. (2011).^[25] This means the more the dentists stay in practice the more knowledge they acquire and the more they follow protective measures. There was a significant correlation between years of work experience and the dentists who use lead apron and thyroid shield to protect patients daily among the study sample ($p=0.06$) ($n=78$) (table 10). This is in line with a study reported by Rahul et al. (2017)^[46] where there was a significant correlation between awareness of participants and the use of lead aprons ($p=0.05$).

We found a significant correlation between the dentists who do dental X-ray inside the clinic and who know the perfect distance that should be between an operator and dental radiographic machines among the study sample ($p=0.03$) ($n=78$) (table 11). This is similar to a study reported by Rahul et al. (2017)^[46], where there was significant correlation between awareness of participants and perfect positioning of the operator during intraoral dental exposure ($p=0.001$).

We found a significant correlation between the dentists who know that less exposure is required in digital radiography compared to conventional radiography and who stand behind a protective barrier during exposure to radiation among the study sample ($p=0.009$) ($n=78$) (table 13). This is similar to the study done by Lingam et al. (2017)^[47], in which there was a significant correlation between the dentists who know that less exposure is required in digital radiography compared to conventional radiography ($p=0.091$).

We found a significant correlation between the dentists who know the effective dose estimate range and those who check their radiographic machine regularly among the study sample ($p=0.008$) ($n=78$) (table 14). This is in line with the study of Lingam et al. (2017)^[47] that there was a significant correlation between knowledge and awareness of deterministic and stochastic effects ($p=0.04$).

There was a significant correlation between the dentists who know the stochastic effects of radiation and those who stand behind a protective barrier during exposure to radiation among the study sample ($p=0.009$) ($n=78$) (table 15). Similarly, Rouwan et al. (2016)^[12] reported that there was significant correlation between knowledge and awareness of deterministic and stochastic effects ($p=0.087$); Lingam et al. (2017)^[47] also confirm this correlation ($p=0.04$).

There was a significant correlation between the dentists who know X-ray can be reflected from the walls of a room and those who stand behind a protective barrier during exposure to radiation among the study sample ($p=0.007$) ($n=78$) (table 16). Rouwan et al. (2016)^[12] also found that there was a significant correlation between knowledge and awareness that X-ray beams reflect from the walls of a room ($p=0.039$). A study by Lingam et al. (2017)^[47] ($p=0.044$) and that of Rahul et al. (2017)^[46] also confirm this correlation ($p=0.001$).

We found a significant correlation between the dentists who know ICRP protection protocol and those who wear TLD badges daily among the study sample ($p=0.01$) ($n=78$) (table 17). This is contrary to Lingam et al. (2017)'s study^[47] that there was no significant correlation between the dentists' knowledge about ICRP protection protocol and wearing of TLD badges.

CONCLUSION:

The results obtained from this study indicate that the level of knowledge among dentists and X-ray technologists are considered to be excellent (97.4%), the practice and attitude of the dentists toward protection from radiation are poor (75%), while it was good among X-ray technologist (100%); the significant correlation between their knowledge and attitude is represented as $p=0.003$. The reason for the poor attitude is because 42.3% of the X-rays in the private dental clinics are done by nurses. There is need for more restriction to ensure that dental patients are highly protected from radiation.

Recommendation

- There is the need for competent authority of the ministry of health to visit all radiation departments in private dental clinics to regulate the examination of dental patients regarding radiation and to raise the level of protecting patients from radiation.
- There is the need for training and recertification programs for

effective radiation protection practices among dentists; all dental clinics should hold more workshops, short-term training courses, preparation and distribution of posters on protection and safety against ionizing radiation in order to raise radiology department.

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