

Assessment of Knowledge and Perspective toward Dental Radiography among Dental Practitioners of Sindh Province Pakistan

Imran Samejo¹, Bharat Kumar², Hira Musharraf³, Jamshed Ahmed⁴, Lubna Memon⁵, Rukhsana Bhatti⁶

¹Department of Prosthodontics, Sindh Institute of oral Health Sciences, Jinnah Sindh Medical University, Karachi, Pakistan. ²Department of Prosthodontics, Dow International Dental College, Dow University of Health Science, Karachi, Pakistan. ³Department of Prosthodontics, Dow Dental College, Dow University of Health Science, Karachi, Pakistan. ⁴Department of Operative Dentistry, Sindh Institute of Oral Health Sciences, Jinnah Sindh Medical University, Karachi, Pakistan. ⁵Department of Prosthodontics, Dr. Ishrat-Ul-Ebad Khan Institute of Oral Health Sciences, Dow University of Health Sciences, Karachi, Pakistan. ⁶ Al Rehman Hospital and Maternity Home Sukkur, Sindh, Pakistan.

ABSTRACT

BACKGROUND

Radiography is one of the important tools that dentists use to diagnose dental diseases in the oral cavity. Exposure of radiation is associated with hazardous effects on oral tissues. Doctors must have enough knowledge regarding the consequences of radiation exposure. The purpose of this study was to assess knowledge and perspective of dental practitioners towards dental radiography.

METHODS

This descriptive cross-sectional study was conducted in the month of November and December 2020, among dental practitioners who worked in the state of Sindh. All the participants were given the questionnaire survey link through social media including Facebook, WhatsApp, and Email and 24 closed ended questions were asked regarding dental radiography. A total of 247 dental practitioners responded and participated in the study.

RESULTS

Our study showed that only 3.60 % of general practitioners (GP) reported that they did not have radiographic unit. The participant's knowledge regarding the technical details of equipment was limited. Majority of dental practitioners preferred long cone, more than 50 % specialist recommended F-speed of film. 34.53 % of general dentists and 37.73 % of specialists responded that they have digital radiography. More than 50 % of dental practitioners didn't have license for x-ray equipment. Majority of them utilized paralleling technique for periapical x-ray. 63.40 % of GP and only 11.32 % of specialist held x-ray film with the fingers when taking x-ray. 30.41 % of GP and 24.52 % of specialist took the radiographs themselves, whereas 35.05 % had x-ray done by technician. Only 1.54 % of GP and 3.775 % of specialists gave the radiographic packing materials to specialized company in order to discard the waste materials. Only 6.70 % of GP and 11.32 % of specialists had the walls of the x-ray room covered with lead.

CONCLUSIONS

This study concluded that dental practitioners have little knowledge regarding dental radiography.

KEY WORDS

Knowledge, Perspective, Dental Practitioners, Dental Radiology

Corresponding Author:

*Dr. Bharat Kumar,
Department of Prosthodontics,
Dow International Dental College,
Chanesar Goth Mehmoodabad Road,
Karachi, Pakistan.
E-mail: bharat.kumar@duhs.edu.pk*

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BACKGROUND

Radiography is one of the important tools that dentists use to diagnose dental diseases and malformations in the oral cavity.¹ Dental radiographs are a key factor of a comprehensive treatment plan to diagnose and manage oral diseases.² Periodontal diseases can be diagnosed clinically; nevertheless, dental radiography is needed to complete the results, illuminating the current bone level score, degree of bifurcation involvement, tooth-to-root ratio, periodontal ligament space enlargement, and apical involvement.³ As suggested by American Dental Association (ADA) guidelines, the radiographic recommendations are based on clinical signs and symptoms, such as tooth sensitivity, clinically visible impacted teeth and mobility.⁴ Exposure of radiation to any part of the body has a similar level of risk associated with it. Dental radiology is also associated with similar hazardous effects on oral tissues.⁵ Most dental radiological procedures involve ionizing radiation. Ionizing radiation has enough energy which is powerful enough to change the stable atoms to unstable.⁶ Previous studies have shown that the ionizing radiation used in dental radiography increases risks to the salivary gland, thyroid and increases the likelihood of brain tumors.⁷ Hence, it is necessary that dentists perform maxillofacial and oral radiology thoughtfully and responsibly to maximize diagnostic benefits while minimizing the dose of radiation to the patient.⁸ deoxy ribo nucleic acid (DNA) can be damaged by ionizing radiation. Dental healthcare professional can be unprotected to ionizing radiation from stray radiation, and care must be taken in order to lessen or eradicate operator exposure.⁹ Dosimeter is used to display the dose to which the operator is exposed over time and should not exceed 5 rem (50 mSv) per annum. However, 50 mSv, is the dose limit per annum and 1 mSv is the average effective dose, indicating that the National Council on Radiation Protection and Measurements (NCRP) commendations had a significant impact on dental radiation protection standards.⁸ Do not expose the operator to the position indicating device (PID) during exposure. If the x-ray machine is unstable or drift occurs, the unit should be inspected immediately.¹⁰ In the past decade, numerous computer-based digital imaging technologies have emerged in the field of maxillofacial radiology, oral radiology, and dentistry.¹¹ Digital radiography has largely replaced the traditional film-based technique. Radiation dose can be reduced to the patient by use of long cone when compared to the short cone as the x-ray beam of radiation is less divergent and therefore less tissue breakdown occurs.¹² The film speed currently available for intra-oral radiography is from D-Speed to F-Speed, ranging from slow to fast speed respectively. Faster film speeds should be used to get images for diagnosis purpose.¹³ High quality diagnostic images can be obtained with a reduced patient dose if dentists follow standard radiographic procedures, including well-trained staff, faster image receptors and screen / film combinations, shielding, accurate techniques and recommended equipment.¹⁴ The film can be placed accurately by using film holding devices. This eliminates unnecessary exposure to the operator and reduces the repeating of radiographs.¹⁵ Radiation has the potential of harm to human beings as its exposure can cause skin cancer and have other long-term effects on sensitive body organs, including glands.¹⁶ Dentists must have complete awareness of negative effects of x-rays.¹⁷ Patients worry about their

exposure to radiation and the associated risk to their health.¹⁸ Doctors must have enough knowledge regarding the consequences of radiation exposure to satisfy their patients.¹⁹ No survey has been done regarding radiographic knowledge in Pakistan. The information obtained from this survey will provide a baseline data which could be used to develop strategies aimed at educating clinicians on the importance and risks associated with dental radiography.

METHODS

This descriptive cross-sectional study was conducted in November and December 2020, among general dental practitioners and specialists working at the state of Sindh Pakistan. The institutional ethical committee approval was obtained and informed consent from participants was taken. Those dental practitioners who refused to give informed consent were excluded from the study. All the participants were given with the option of not providing their names for maintaining their confidentiality. A structured questionnaire was taken from previous study¹¹ and some modifications were made and revalidated by discussing it with senior teaching faculty. Questionnaire was kept on Google forum and link was sent to 300 participants through social media including Facebook, WhatsApp, and Email by non-probability consecutive sampling. Questionnaire had 24 closed ended questions regarding dental radiography and to measure knowledge and perspective of dental practitioners towards dental radiography. Questionnaire was composed of two portions. Questions in first portion were related to demographic data such as age, gender, current position and duration of practice, along with a series of questions asking respondents to report details relating to their clinic and the practice of dentistry within their clinic. In second portion, the respondents were tested with questions serving to determine their level of knowledge in the areas of radiation and dental radiography.

Statistical Analysis

Statistical package for social sciences (SPSS) V.23 was used for data entry and analysis. The descriptive statistics such as frequency and percentages of participants, their type of practice, duration of experience and response to questions regarding dental radiography were calculated.

RESULTS

Out of the total 300 questionnaires distributed, 247 responses were received from different dental practitioners thus a response rate of 82.33 % was obtained. Among them 149 (60.32 %) were male and 98 (39.67 %) female, mean age of participants was 37 + 11.4 years. Frequency and percentage of participant's title is shown in Figure 1. Among all participants 45 (18.21 %) practiced at their own clinic, 145 (58.70) practiced at institutes hospital, while 57 (23.07 %) worked both at their personal clinic and institutes. Working experience of all participants with 1 - 3 years was 26 (10.52

), 4 - 6 years was 86 (34.81 %), 7 - 9 years was 58 (23.48 %) and 10 years & above was 77 (31.17 %) respectively. Only 7 (3.60 %) general practitioners reported that they did not have radiographic unit. The participants knowledge regarding the technical details of equipment was limited, with 139 (71.64 %) general practitioners and 16 (30.18 %) not knowing the kilo voltage peak (kVp) of x-ray machine, and those knowing were using 65 kVp.

34 (17.52 %) GP and 8 specialists (15.09 %) reported having rectangular collimators. It was observed that more than fifty percent specialist recommended F-speed of film while 47 (24.22 %) GP and 3 (5.66 %) specialists did not have any awareness about speed of film they used. Only 67 (34.53 %) general dentists and 20 (37.73 %) specialist responded that they had digital radiography and 51 (26.28 %) GP and 17 (32.07 %) specialist had panoramic unit. More than 50 % of dental practitioners didn't have license for x-ray equipment.

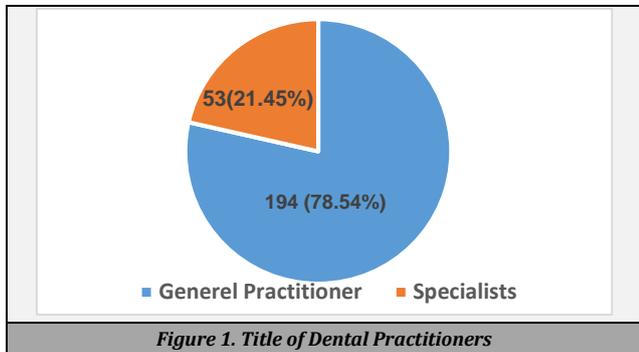


Table 2 shows the distribution of radiographic technique utilized by dental practitioners, majority of them utilized paralleling technique for periapical x-ray. 107 (55.15 %) of GP did not use film holder, while 40 (75.47 %) specialist utilized film holder. 123 (63.40 %) of GP and only 6 (11.32 %) specialist held x-ray film with the fingers when taking x-ray. Majority of them adjusted the exposure time of x-ray. Only 17 (8.76 %) of GP and 9 (16.98 %) specialist used dosimeter to measure the radiation dose. Fifty-nine (30.41 %) GP and thirteen (24.52 %) specialists reported that they took the radiographs themselves, whereas 35.05 % had x-ray done by technician. Most of the practitioners had taken 0 - 10 x-ray per week in their practice. 49 (92.45 %) specialists and only 85 (43.81 %) GP utilized view-box for examination of x-ray.

Table 1 shows the distribution of radiographic equipment utilized by dentists according to title of dental practitioners. Majority of dental practitioners preferred long cone and only

		Radiographic Equipment				
		Yes		No		
Q: 1 Do you have X-ray equipment in your clinic / hospital?	General practitioner (194)	187 (96.39 %)	7 (3.60 %)			
	Specialist (53)	53 (100 %)	0 (0 %)			
Q: 2 The cone type of your x-ray?			Short cone	Long cone	Pointed cone	No idea
	General practitioner (194)	53 (27.31 %)	84 (43.29 %)	0 (0 %)	57 (19.38 %)	
	Specialist (53)	19 (35.84 %)	27 (50.94 %)	0 (0 %)	7 (13.20 %)	
			Rectangular	Rounded	No idea	
Q: 3 Which type of collimator do you use?	General practitioner (194)	34 (17.52 %)	51 (26.28 %)	109 (56.18 %)		
	Specialist (53)	8 (15.09 %)	17 (32.07 %)	28 (52.83 %)		
Q: 4 The speed of the periapical film that you used?			D-speed	E-speed	F-speed	No idea
	General practitioner (194)	11 (5.67 %)	62 (31.95 %)	74 (38.14 %)	47 (24.22 %)	
	Specialist (53)	7 (13.20 %)	14 (26.41 %)	29 (54.71 %)	3 (5.66 %)	
			Yes	No		
Q: 5 Do you have a digital radiography device in your clinic?	General practitioner (194)	67 (34.53 %)	127 (65.46 %)			
	Specialist (53)	20 (37.73 %)	33 (62.26 %)			
Q: 6 Do you have a panoramic radiography device in your clinic?			Yes	No		
	General practitioner (194)	51 (26.28 %)	143 (73.71 %)			
	Specialist (53)	17 (32.07 %)	36 (67.92 %)			
			Yes	No		
Q: 7 Do you have a license for your x-ray equipment?	General practitioner (194)	71 (36.59 %)	123 (63.40 %)			
	Specialist (53)	24 (45.28 %)	29 (54.71 %)			

Table 1. Distribution of Radiographic Equipment Utilized by Dental Practitioners

		Radiographic Techniques				
		Paralleling technique	Bisecting angle technique	Both	No idea	
Q: 8 Which technique do you utilize in taking periapical radiographs?	General practitioner (194)	97 (50 %)	61 (31.44 %)	19 (9.79 %)	17 (8.76 %)	
	Specialist (53)	41 (77.35 %)	3 (5.66 %)	9 (16.98 %)	0 (0 %)	
Q: 9 Do you utilize a film holder while taking radiographs?	General practitioner (194)	87 (44.84 %)	107 (55.15 %)			
	Specialist (53)	40 (75.47 %)	13 (24.52 %)			
Q: 10 Do you or your assistant hold the x-ray film with the finger while taking periapical radiographs?			Yes	No		
	General practitioner (194)	123 (63.40 %)	71 (36.59 %)			
	Specialist (53)	6 (11.32 %)	47 (88.67 %)			
			Yes	No		
Q: 11 Do you adjust the exposure time according to the location of the tooth where the radiograph will be taken?	General practitioner (194)	171 (88.14 %)	23 (11.85 %)			
	Specialist (53)	48 (90.56 %)	5 (9.43 %)			
Q: 12 Do you use dose meter to measure the radiation dose?			Yes	No		
	General practitioner (194)	17 (8.76 %)	177 (91.23 %)			
Specialist (53)	9 (16.98 %)	44 (83.01 %)				
Q: 13 Who takes the x-rays in your practice?			Dental practitioner	X-ray technician	Dental assistant	
	General practitioner (194)	59 (30.41 %)	68 (35.05 %)	67 (34.53 %)		
	Specialist (53)	13 (24.52 %)	17 (32.07 %)	23 (43.39 %)		
Q: 14 Approximately how many periapical films are taken in your practice every week?			0-10	11-20	21, above	
	General practitioner (194)	123 (63.40 %)	57 (29.38 %)	14 (7.21 %)		
	Specialist (53)	18 (33.96 %)	20 (37.73 %)	15 (28.30 %)		
Q: 15 Do you use view-box when you examine radiographs?			Yes	No		
	General practitioner (194)	85 (43.81 %)	109 (56.18 %)			
Specialist (53)	49 (92.45 %)	4 (7.54 %)				

Table 2. Distribution of Radiographic Technique Utilized by Dental Practitioners

Radiographic Processing						
Q: 16 Which type of film processing do you utilize?	Automatic processing device		Manual	Self-processing	No idea	
	General practitioner (194)	107 (55.15 %)	59 (30.41 %)	19 (9.79 %)	9 (4.63 %)	
Specialist (53)	37 (69.81 %)	11 (20.75 %)	3 (5.66 %)	2 (3.77 %)		
Q: 17 How frequently do you change processing solutions?	Every day		One week	Two weeks	Three weeks	No idea
	General practitioner (194)	37 (19.07 %)	45 (23.19 %)	13 (6.70 %)	8 (4.12 %)	91 (46.90 %)
	Specialist (53)	15 (28.30 %)	19 (35.84 %)	9 (16.98 %)	3 (5.66 %)	7 (13.20 %)
Q: 18 How do you discard radiographic processing solutions (developer, fixer)?	Throw in the sink		Dilute in water and throw in the sink	Through a specialized company		
	General practitioner (194)	129 (66.49 %)	65 (33.50 %)	0 (0 %)		
	Specialist (53)	34 (64.15 %)	19 (35.84 %)	0 (0 %)		
Q: 19 How do you discard the radiographic packing materials?	Throw in garbage can		Through a specialized company			
	General practitioner (194)	191 (98.45 %)	3 (1.54 %)			
	Specialist (53)	51 (96.22 %)	2 (3.77 %)			

Table 3. Distribution of Radiographic Processing Utilized by Dental Practitioners

Radiation Protection			
Q: 20 Are the walls of the x-ray room covered with lead?	Yes		No
	General practitioner (194)	13 (6.70 %)	181 (93.29 %)
Specialist (53)	6 (11.32 %)	47 (88.67 %)	
Q: 21 Do you have a protecting barrier in your practice?	Yes		No
	General practitioner (194)	101 (52.06 %)	93 (47.93 %)
Specialist (53)	41 (77.35 %)	12 (22.64 %)	
Q: 22 Do your patients wear a lead apron while being exposed to x-ray?	Yes		No
	General practitioner (194)	91 (46.90 %)	103 (53.09 %)
Specialist (53)	27 (50.94 %)	26 (49.05 %)	
Q: 23 Do your patients wear a thyroid collar while being exposed to x-ray?	Yes		No
	General practitioner (194)	11 (5.67 %)	183 (94.32 %)
Specialist (53)	7 (13.20 %)	46 (86.79 %)	

Table 4. Distribution of Radiographic Protection Utilized by Dental Practitioners

Table 3 shows the distribution of radiographic processing utilized by dentists, among half of them preferred automatic processing device for processing of radiographic film. Most of the GP did not have any idea regarding changing of processing solution and only 15 (28.30 %) of specialists changed their processing solution every day. Only 3 (1.54 %) GP and 2 (3.775 %) specialists gave the radiographic packing materials to specialized company in order to discard the waste materials.

Table 4 shows the distribution of radiographic protection, only 13 (6.70 %) GP and 6 (11.32 %) specialists responded that their walls of the x-ray room were covered with lead. 101 (52.06 %) of GP and 41 (77.35 %) specialists had protecting barriers and 91 (46.90 %) GP and 27 (50.94 %) specialist provided their patients with lead apron while being exposed to radiations. The utilization of a thyroid collar for patients among specialists was 11 (5.67 %) and GP was 7 (13.20 %).

DISCUSSION

In the recent years, there has been a greater reliance on radiographic technology in the field of dentistry as the advancements and dynamically evolving changes have made it easier to reach upon an accurate diagnosis in a shorter frame of time.^{14,20} Since there is an increase in the use of radiology there is a need that the dentists are properly educated and trained in this field so as to reduce the exposure of x-rays both to the patient and to the dentist.¹⁴

According to this survey, most of the participants had limited knowledge about the technical details of the x-ray equipment that they were using with 139 (71.64 %) general practitioners and 16 (30.18 %) specialists not knowing the kilo voltage peak of x-ray machine, and those knowing were using 65 kVp. Ideally the kVp of x ray machine should be between 60 kVp and 70 kVp.²¹

The aim of dental radiography is to produce sharp high-quality images with minimal exposure to both the patient and the dental professionals.²² Using long distance to focus distance of 40 cm rather than short distances of 20 cm reduces the radiation exposure by 10 % to 25 %.¹¹ In this survey, majority of the dentists preferred using long cone technique. Rectangular collimators help in further reducing the delivered radiographic dose by up to fivefold as compared to round collimators and therefore should be used.²³ Despite these figures available, 51 (26.28 %) general practitioners and 17 (32.07 %) specialists in this study preferred to use round collimators whereas most of the dentists did not have any idea about the collimation. Film speed is an important factor in determining the amount of exposure to x rays and the exposure can be minimized by using the fastest speed film.^{13,23,24} The film used for intra oral radiography falls into three classes D speed (slowest), E speed and F speed (fastest).^{13,23} Most of the specialist dentists in this study recommended F-speed of film while 47 (24.22 %) GP and 3 (5.66 %) specialist did not have any awareness about speed of film they used. This data shows that more awareness needs to be made about the benefits of using f speed films.

Digital imaging system permits production of dynamic images with immediate display of the image, storage of images, allow their recovery and ease of transmission.²⁵ Digital sensors are more sensitive than conventional films and also reduce the amount of radiation delivered to the patient and hence should be the preferred technology to be adopted in the recent times.^{25,26} This survey showed that only 67 (34.53 %) general dentists and 20 (37.73 %) specialist had digital radiography. Most of the general dentists 143 (73.71 %) and specialists 36 (67.92 %) did not have panoramic radiographic unit at their clinics. This may be due to the high cost of these units.

In Pakistan, the Pakistan nuclear regulations authority (PNRA) gives license for the radiological units kept at any practice. According to this survey more than 50 % of dental

practitioners didn't have license for x-ray equipment. More stricter actions need to be taken to ensure that all radiological equipments are licensed so that better monitoring of the x ray units can be done.

The paralleling technique for x ray when done correctly produces images with minimum distortion, having better linear and dimensional accuracy.^{11,26} The bisecting angle technique is one of the old techniques used for taking periapical radiographs which is difficult to reproduce and can result in image distortion.^{26,27} According to the overall data in this study, most of the dentists used paralleling technique with more general dentists 61 (31.44 %) using the bisecting angle technique as compared to the specialists 3 (5.66 %). More awareness should be made about the paralleling technique at the undergraduate level so that all dentists apply this technique in their practice. When making periapical and bitewing radiographs the use of film holders allows images of higher quality to be produced and thus also reduces the number of x rays that have to be retaken.²⁷ In this survey, a greater number of specialists 40 (75.47 %) when compared to general dentists 107 (55.15 %) used film holders in their practices.

Guidelines state that film should never be held by hands by dental personals while making x-ray as it can lead to tumorous lesions on hands.²⁷ Even in special circumstances where patient may have special need, the film should be held by a relative wearing protection.^{16,27} Unfortunately holding the periapical film by hands is still practiced in modern dentistry. In this study, 123 (63.40 %) GP and only 6 (11.32 %) specialist held x-ray film with the fingers when taking x-ray.

In the present study, most of the dentists 171 (88.14 %) GP and 48 (90.56 %) specialists adjusted the exposure time of x-ray. The quality of radiographic image is affected by exposure settings as well as film processing procedures. To produce dental radiographs of better diagnostic quality the operator should set the amperage and time settings for exposure of dental radiographs.²⁷

Only 17 (8.76 %) GP and 9 (16.98 %) specialists used dosimeter to measure the radiation dose. These results show that stricter measures should be taken to ensure the application of dosimeters in all dental setups so that patients are exposed to only minimum necessary doses of radiation. In dentistry, the entrance surface air kerma (ESAK) for intraoral examinations and dose width product (DWP) for panoramic examinations are the most commonly used dose parameters for setting diagnostic reference levels (DRLs).²⁸

Where jurisdiction allows auxiliary dental staff may take dental radiographs provided they are well trained in their task, have knowledge about infection control and the leading dentist plays an active supervisory role in ensuring maintenance of high technique standards.^{29,30} Fifty nine (30.41 %) of the GP and thirteen (24.52 %) specialists reported that they took the radiographs themselves, whereas 35.05 % had x-ray done by technician. For accurate diagnosis it is imperative that x rays are viewed under appropriate conditions such as an illuminated viewer.³¹

When x rays are viewed without appropriate light, there is a chance that important conditions may remain undiagnosed.^{31,32} In this study, 49 (92.45 %) specialists and only 85 (43.81 %) GP utilized view-box for examination of x-

ray. Automatic processing of films has a number of advantages over manual processing foremost of which is the saving of time.³² In the past it was hard to uphold image quality as maintenance of small dark rooms was a difficult task.^{32,33} In this survey half of the dentists preferred automatic processing device for processing of radiographic film. To maintain the image quality of x rays, the processing solutions should be checked daily and should be changed according to manufacturer's instructions or if there is any evidence of declining quality of current film.^{27,34,35} Most of GP in this survey did not have any idea regarding change of processing solution and only 15 (28.30 %) specialists changed their processing solution every day.

Because of the silver content present in fixer solutions they may be considered as hazardous solutions.²⁷ Both the fixer solution and lead foil from the film packet should be discarded as per state regulations and should be discarded in containers to be transported to disposal sites.²⁷

According to data collected, only 3 (1.54 %) GP and 2 (3.775 %) specialists gave the radiographic packing materials to specialized company in order to discard the waste materials. According to recent guideline routines, use of lead apron for dental radiography during modern times is not necessary, however when deemed necessary as in the case of pregnant women or when any of the recommendations are not followed then lead aprons may be used.^{27,32,36} The risk to thyroid from exposure to x rays has been well documented and thyroid gland should be shielded as much as possible without reducing the quality of radiographs to reduce its exposure to x rays.^{27,32}

According to a study conducted by Sikorski and Taylor³⁷ wearing of a thyroid collar reduces the risk of thyroid gland to harmful exposure of x-rays by 2 - 18 % for bitewing radiographs, 5 - 56 % for a full mouth series of radiographs, and 10 - 79 % for panoramic radiographs. According to the data collected in this study, only 13 (6.70 %) GP and 6 (11.32 %) specialists responded that their walls of the x-ray room were covered with lead. 101 (52.06 %) GP and 41 (77.35 %) specialists had protecting barriers and 91 (46.90 %) GP and 27 (50.94 %) specialists provide their patients lead apron while being exposed to radiations. The utilization of a thyroid collar for patients among specialists was 11 (5.67 %) and GP was 7 (13.20 %).

CONCLUSIONS

This study concluded that both, general dental practitioners, and specialists had little knowledge regarding dental radiography. But the specialists had better knowledge when compared to general dental practitioners. Best practices legislation guidelines of dental radiology are lacking. Dentists should be updating their radiology practice for a comprehensive health care system. Deficiencies and areas of weakness in radiographic practices can be identified by periodic surveys. Regular training for radiation safety is necessary to strengthen the safety practices as well as staying on safety standards. Participation in radiation safety courses can help clinicians to reduce patient risk and improve their safety protection.

Data sharing statement provided by the authors is available with the full text of this article at jemds.com.

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