



Attitude of the Moroccan dentist population towards radiation protection

Naoual Elmorabit^{1}, Majdouline Obtel², Mohamed Azougagh³, OumKeltoum Ennibi¹*

1. Mohammed V University in Rabat, Faculty of Dental Medicine, Laboratory of Research on Oral Biology and Biotechnology, Morocco.

2. Mohammed V University in Rabat, Faculty of Medicine and Pharmacy, Department of Public Health, Morocco.

3. Mohammed V University in Rabat, National Graduate School of Arts and Crafts (ENSAM), Morocco.

Abstract

Dental radiography has become an essential part of clinical dental practice. However, the significant risk associated with radiation should not be underestimated by dentists. The current study aims to assess radiation protection attitudes among Moroccan dentists. It was a cross-sectional study based on a questionnaire, included 325 dentists practicing in the rabat-salé-kénitra region. The collected data were analyzed using the IBM SPSS Statistical program. Demographic characteristics and descriptive data were expressed by frequencies and percentages. Pearson Chi-square test was used for data comparison. Non-parametric statistical tests were used. The level of significance was set at 5%. The results showed that 90.3% of the dentists considered clinical examination of patients before prescribing/taking X-rays to patients. 44.7% of them never explained to their patients about radiation risks/benefits before the radiographic exposure. 97% of dentists always asked patients about pregnancy before radiographs. To protect against x-rays, 60.2% of dentists stood behind a protective barrier, 47.1% of them used of the lowest exposure setting as possible, 15% of them wore lead aprons and only 11.9% used rectangular collimator. More than 96% of dentists never used a dosimeter while working. Majority of the dentists never used thyroid shields and lead aprons to protect patient (96.8% and 91.2% respectively). The median attitude score in this study was 30[28; 32] on a scale of 17 to 51. This study concluded that the Moroccan dentist's attitude towards radiation protection needs to be significantly improved to prevent radiation risks.

Keywords: Radiation Protection, Dentists, Attitude, Dental radiography, Dentistry.

Full length article *Corresponding Author, e-mail: nawal.elmorabit@gmail.com

1. Introduction

Dental X-ray imaging has become an essential part of clinical dental practice [1]. Although the dose, and therefore the risk, associated with well-conducted dental examinations remains low, as the prevalence and frequency of such examinations are high, the risks associated with the cumulative effect of repeated exposure should not be underestimated [2]. Indeed, both the patients and the dentists are in a high-risk situation due to possible stochastic effects in dental radiology which can be initiated in tissues either affected by the direct beam or exposed to scattered radiation [3-5]. In several studies, it has been associated with an increased risk of thyroid cancer [6-7]. Hwang et al., 2019 showed in a systematic review the evidence of increased risk of head and neck cancer due to exposure to low doses of dental X-ray and emphasize that accumulative exposure to low-dose radiation from dental X-rays cannot be ruled out

and cannot be ignored [8]. Therefore, special attention should be given to dental X-rays justification and optimization in order to protect dental staff and patients from unnecessary radiation exposure [9]. Generally, dentistry is an independent practice in the provision of health care and often includes self-financing for the acquisition of radiological equipment. This weighs directly or indirectly in dentists' decision to prescribe radiological examinations that they perform themselves. In fact, knowing that over-prescription of imaging can result in unnecessary radiation exposure and additional financial costs for patients, dentists are often caught between the responsibility of justifying medical exposure and optimizing patient radiation protection on the one hand, and financial pressures on the other [4,10].

The issue of radiation must be taken into consideration by every dentist; otherwise, it will become quite dangerous. This involves having sufficient knowledge to consciously use

radiographs and develop positive attitudes which can improve radiation protection behaviors [11-12]. However, despite the considerable and easily achievable methods of dose reduction, such as the use of rectangular collimation, protective barriers. Several authors have reported that too many dentists were reluctant to adopt these methods [13-14]. The reasons remain unknown, but it is possible that their reluctance is linked to their attitude towards radiological risks. The aim of this paper is to assess radiation protection attitudes among Moroccan dentists.

2. Materials and methods

The study was conducted in the region of Rabat-Salé-Kenitra, in Morocco. It was a cross-sectional study based on a questionnaire, conducted from April 2022 to June 2022. Ethical approval was received from the Ethics Committee for Biomedical Research of the Mohammed V University in Rabat, Faculty of Dentistry, Rabat, Morocco (CERB n° 2/22). The purpose of the study was explained, and informed and written consent was obtained from all study participants. The study required a sample size of 295 as calculated online with 95% confidence level and 5% error margin. To avoid non-respondents, we considered adding 10% of the calculated sample to the population. The final targeted practitioners sample size was 325 dentists. The questionnaire form including multiple choices questions was developed after a review of the literature relevant to attitudes regarding radiation protection in dentistry [15,2] and international guidelines and national Moroccan regulations. The draft questionnaire was approved by a professor of dentistry, a teacher-researcher specialized in nuclear physics, a medical physicist and a Radiation Protection Officer. The questionnaire was pretested for ambiguity and clarity and all necessary changes were made. Participants were reached and invited to take part in the study by direct contact with the principal investigator or by telephone calls, emails and SMS. The questionnaire was used to collect data either by hard copy or electronic file sent via email and social media platforms (WhatsApp, Facebook), to inaccessible areas, following a phone call with the dental managers. The questionnaire had two parts; the first part included General information regarding demographic data (gender, age range and Years of experience), workplace setting, type of practice, continuous training received in radiation protection, type (s) of dental X-ray equipment, the second part had seventeen (17) questions to evaluate dentists' attitudes towards radiation protection. Questions on attitudes were multiple choice questions as well. Participants were asked to mark the answer that best corresponds to their individual experience or perception of radiation protection in dental practice. These questions allowed the respondent to choose between the options "never", "sometimes", and "always". While the positive attitude received three points, the negative one received one point. Therefore, the range of scores in the section measuring attitudes was between 17 and 51. The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS v. 23.0). Demographic characteristics and descriptive data were expressed by frequencies and percentages. Pearson Chi-square test was used for data comparison. The normality of the data was checked by Shapiro-Wilk statistics. Non-parametric statistical tests (Kruskal-Wallis and Mann Whitney U-test) were used. A binary logistic regression analysis of the Socio-demographic and professional

Elmorabitet et al., 2023

characteristics with positive attitude score was used to find predictors of radiation protection attitudes. Statistical results were considered significant at $p < 0.05$.

3. Results

Out of a total of 325 questionnaires distributed, 320 responses were received, resulting in a response rate of 98.46%. Among study population, 64.1% were female and 35.9% were male. 34.4% of participants were under 29 years old, 36.3% were aged between 30 and 39 years, 18.4% were aged between 40 and 49, while the rest of the studied population was aged 50 years or older. The experience in dental practice was less than 10 years for 63.8% of the participants. 64.4% of dentists were general dental practitioners (GDP) and 35.6% were specialists. Among all participants 67.5% were working at private practice (PP), and 32.5% at dental public health service (DPHS). 100% of the dentists received courses about radiation protection during their studies, and 49.1% of them had received continuous training in dental radiation protection. Regarding radiographic equipment in their practice, 87.2% of participants had intraoral X-ray units, 28.1% of them had extraoral X-ray units, 11.9% had mobile or hand-held device and only 6.6% dentists did not have any radiographic unit. Table 1 shows the perceptions and attitudes of the study participants regarding various aspects of a radiographic prescription and radiation protection. 90.3% of practitioners reported that the prescription of X-rays to patients was performed after a clinical examination, while 16.2% of dentists prescribed radiograph examination based on the patient's history, and 10.6% of the dentists expressed a preference for routine ordering of radiographs. The use of x-ray examination to evaluate new patients was a quite common attitude among Moroccan dentists. 59% of participants either always or sometimes prescribed/performed panoramic radiography to evaluate a new patient, while 59.8% of them either sometimes or always utilized intraoral radiography and 82.1% have never requested x-rays from the previous dentist. More than 80% of dentists either always or sometimes prescribed/performed radiographs on request by third parties for administrative purposes only (for an insurance company or for an examining board). There was a statistically significant difference according to workplace setting ($p < 0.0001$) and between the specialists and GDPs ($p < 0.0001$). 44.7% of participants never explained to their patients about radiation risks/benefits before the radiographic exposure. More than 97.5% of dentists always asked patients whether they were pregnant or not before the imaging procedure. 63.4% never prescribed/performed dental imaging on pregnant patients, 33.8 did it only in case of an emergency. Dentists adopted various precautions to ensure their own protection against radiation, including standing behind a protective barrier for 60.2% of them, using the lowest exposure setting as possible for 47.1%, wearing the lead aprons for 15% of them and using rectangular collimator for 11.9%.

However more than 96% of dentists never used a dosimeter while working and majority of them never used thyroid shields and lead aprons for patients in their practice on a regular basis (96.8% and 91.2% respectively). The median attitude score in this study was 30 [28; 32] on a scale of 17 to 51 (Table1). There was a statistically significant difference between responses according to dentist

qualification ($p < 0.0001$), to workplace setting ($p < 0.0001$). The attitude score of dental specialists were found to be significantly higher than the attitude score of general dental practitioners. The findings of the study showed no significant difference in terms of attitudes on radiation protection according to the gender of the participants, to their age and years of professional experience ($p=0.45$; $p=0.80$ and $p=0.46$ respectively). In univariate analysis, dentists worked in private practice were about 54% times less likely to have a positive attitude on radiation protection as compared to dentists in public dental health service ($OR=0.46$; $p=0.026$). In addition, dentist specialist were 3 times more likely to have a positive attitude on radiation protection as compared to GDPs ($OR=3.01$, $p=0.002$). The result of multivariate logistic regression analysis showed that dentist qualification ($OR=2.90$ and $p=0.01$) was significant predictor of Attitude (Table 2).

4. Discussions

The results of present study showed that among the 320 responder dentists, 90.3% of them either sometimes or always prescribed/performed radiographs to patients after a clinical examination. Similar to studies carried by Kaur et al. and Al Faleh et al. (98.5% and 51.7% respectively), however, Campbel et al. reported that only 33% of dentists examined patients before radiographs [16-17,13]. 16.2% of dentists either sometimes or always considered patient's history necessary before acquiring radiographs, unlike the results presented by Kaur et al., and Al Faleh et al., (98.5% and 51.7% respectively) [16-17]. While 10.6% of them expressed a preference for routine prescription of X-rays. Lee et al., showed that one third of Korean dentists made predetermined routine radiographic examinations [18]. Financial factors may explain the routine use of X-rays by dentists [19]. However, for the justification process to be carried out properly, the prescription of dental radiographs should be based on a patient's history and clinical examination. The routine use of x-rays based on a generalized approach rather than individual prescription is unacceptable [20]. More than 80% of Moroccan dentists either always or sometimes prescribed/performed radiographs on request by third parties for administrative purposes only (for an insurance company or an X-ray examination requested externally). Indeed, in Morocco, this practice is very common for any possible reimbursement by insurance companies. However, administrative use of radiation to provide information that is not necessary for the patient's health shall not be permitted [1]. 44.7% of participants never explained to their patients about radiation risks/benefits before the radiographic exposure, these results are like those reported by Al Faleh et al., and Kaur et al., (40% and 43.3% respectively) [16-17]. This could be due to the workload leading the dentist to reduce the time spent with patients and concentrate more on care, or to avoid any refusal of the radiographic images by the patient, or to an underestimation of the potential risks of radiation exposure.

Dentist should attempt to explain accurately why the radiographs are needed, citing the great benefits that will result from the exam compared to the minimal biologic risks [21]. The 2022 IAEA safety report stated that if the examination is justified, there is no need to postpone a dental radiographic examination until after delivery. Dentists, however, need to be sensitive to the concerns of the patient.

Because most dental x-rays are not urgent, exams can often be delayed if the patient prefers it [4]. Yurt et al., stated that 86.4% of dentists thought that it is unsafe to perform dental imaging on pregnant patients, and 62% of them always asked patients whether they were pregnant or not before the imaging procedure [22]. In the current study, 63.4% of subjects never performed dental imaging on pregnant patients, 33.8% did it only in an emergency and more than 97% of dentists always asked patients about pregnancy before radiographic procedures. However, Shah et al., showed that 64.7% of dentists recommended dental radiographs for pregnant patients [23]. Dentists adopted various precautions, to ensure their own protection against radiation. 58.3% of them always stood behind a protective barrier during radiation exposure, likewise numerous reports [24-25]. It is a fundamental principle of radiation protection that no one other than the patient undergoing the procedure is allowed in the room during radiation exposure. Protective barriers allow the practitioner to avoid the primary X-ray beam or scattered radiation [26].

29.2% of dentists always used the lowest exposure setting as possible and 17.9% of them did it sometimes, similarly to results reported by Ihle et al., [25]. In practice, the operator is advised not to rely on predetermined exposure parameters (kV, mA, time) but rather to actively explore these parameters depending on the imaging system used which will provide images of acceptable diagnostic quality with a lower dose [4,20]. 14.1% of the participants always wore lead aprons. Compared to other results[3,16,24] these findings showed an under-use of lead aprons by Moroccan dentists, which could be due to the unavailability of these aprons in their offices, or they were not enough conscious of the interest of this device, as well as the apron's extra weight. The wearing of lead aprons is necessary for staff present in the room during exposure, particularly when the radiographic workload is high or the room is very tight [27]. The rectangular collimator was always used by 9.7% of dentists and sometimes by 2.2% of them, closely to previous reports[9,24]. Factors explaining this poor use may be the cost of equipment, lack of adequate training, or increased of device centring errors. The rectangular collimation allows the X-ray beam to be adapted to the precise size of the image receptor. It is a key component for dose reduction, radiation protection and compliance with "good practices" in the general framework of dental practice [28]. For dental establishments with intraoral and panoramic equipment, the use of dosimeter (dose measuring device) can provide information on worker exposure and confirm good working practices and regulatory compliance. However, given the low dose received by most dental staff, the provision of routine personal supervision is generally considered desirable but not universally necessary [4,27]. The United States (US) National Council on Radiation Protection and Measurements' (NCRP) report 177 recommends that the provision of personal dosimeters should be considered for workers likely to receive an annual effective dose greater than 1 mSv. In addition, pregnant dental workers should wear personal dosimeters regardless of expected exposure levels [27,1]. More than 96% of dentists never wore dosimeter regularly while working almost similar to the results described by Asha et al. report [24].

Table 1: Dentists' attitudes towards radiation protection according to their Qualification and Workplace setting.

Attitudes items	Responses	Dentist Qualification		P-Value	Workplace setting		P-Value
		G.D.P n=206	Specialist n=114		PDHS n=104	PP n=216	
Prescribing radiographs to patients after a clinical examination	never	26(12.6)	5(4.4)	0.048*	5(4.8)	26(12)	0.06
	sometimes	9(4.4)	5(4.4)		3(2.9)	11 (5.1)	
	always	171(83)	104(91.2)		96(92.3)	179(82.9)	
Prescribing radiographs based on the patient's history	never	170(82.5)	98(86)	0.83	90(86.5)	178(82.4)	0.64
	sometimes	13(6.3)	4(3.5)		5(4.8)	12(5.6)	
	always	23(11.2)	12(10.5)		9(8.7)	26(12)	
Prescribing radiographs routinely	never	179(86.9)	107(93.9)	0.017*	94(90.4)	192(88.9)	0.002*
	sometimes	7(3.4)	5(4.4)		8(7.7)	4(1.9)	
	always	20(9.7)	2(1.8)		2(1.9)	20(9.3)	
Request radiographs from previous dentist to evaluate a new patient	never	174(84.9)	87(77)	0.13 Ki2	84(81.6)	177(82.3)	0.37
	sometimes	12(5.9)	7(6.2)		4(3.9)	15(7)	
	always	19(9.3)	19(16.8)		15(14.6)	23(10.7)	
Prescribing/performing intraoral radiography to evaluate a new patient	never	70(34.1)	58(51.3)	0.001*	53(51.5)	75(34.9)	0.012*
	sometimes	22(10.7)	18(15.9)		13(12.6)	27(12.6)	
	always	113(55.1)	37(32.7)		37(35.9)	113(52.6)	
Prescribing/performing panoramic radiography to evaluate a new patient	never	93(45.4)	37(32.7)	0.03*	32(31.1)	98(45.6)	0.008*
	sometimes	47(22.9)	24(21.2)		21(20.4)	50(23.3)	
	always	65(31.7)	52(46)		50(48.5)	67(31.2)	
Prescribing radiographs on request by third parties	never	15(7.3)	31(27.2)	<0.0001*	38(36.5)	8(3.7)	<0.0001*
	sometimes	9(4.4)	10(8.8)		7(6.7)	12(5.6)	
	always	182(88.3)	73(64)		59(56.7)	196(90.7)	
Explaining the risks/benefits of irradiation to patients before the imaging procedure	never	101(49)	42(36.8)	0.11	36(34.6)	107(49.5)	0.03*
	sometimes	88(42.7)	61(53.5)		56(53.8)	93(43.1)	
	always	17(8.3)	11(9.6)		12(11.5)	16(7.4)	
Asking patients about pregnancy before the imaging procedure	never	1(0.5)	1(0.9)	0.16	0(0)	2(0.9)	0.7
	sometimes	6(2.9)	0(0)		1(1)	5(2.3)	
	always	199(96.6)	113(99.1)		103(99)	209(96.58)	
Prescribing/performing dental imaging on pregnant patients	Yes	6(2.9)	3(2.6)	0.015*	5(4.8)	4(1.9)	<0.0001*
	No	142(68.9)	61(53.5)		49(47.1)	154(71.3)	
	Emergency only	58(28.2)	50(43.9)		50(48.1)	58(26.9)	
Wearing a lead apron to protect against X-rays	never	176(85.9)	95(83.3)	0.3	90(86.5)	181(84.2)	0.64
	sometimes	3(1.5)	0(0)		0(0)	3(1.4)	
	always	26(12.7)	19(16.7)		14(13.5)	31(14.4)	
Using rectangular collimator to protect against X-rays	never	179(86.9)	103(90.4)	0.71	98(94.2)	184(85.2)	0.032*
	sometimes	5(2.4)	2(1.8)		0(0)	7(3.2)	
	always	22(10.7)	9(7.9)		6(5.8)	25(11.6)	
Using of the lowest exposure setting as possible to protect against X-rays	never	114(55.6)	55(48.2)	0.22	53(51)	116(54)	0.39
	sometimes	38(18.5)	19(16.7)		23(22.1)	34(15.8)	
	always	53(25.9)	40(35.1)		28(26.9)	65(30.2)	
Standing behind a protective barrier to protect against X-rays	never	88(42.9)	39(34.2)	0.1	34(32.7)	93(43.3)	0.12
	sometimes	2(1)	4(3.5)		3(2.9)	3(1.4)	
	always	115(56.1)	71(62.3)		67(64.4)	119(55.3)	
Using a lead apron to protect patient against X-rays	never	188(92.2)	102(89.5)	0.33	88(84.7)	202(94.4)	<0.0001*
	sometimes	11(5.4)	11(9.6)		16(15.4)	6(2.8)	
	always	5(2.5)	1(0.9)		0(0)	6(2.8)	
Using a thyroid shield to protect patient against X-rays	never	197(96.6)	111(97.4)	1	102(98.1)	206(96.3)	0.28
	sometimes	0(0)	0(0)		0(0)	0(0)	
	always	7(3.4)	3(2.6)		2(1.9)	8(3.7)	
Wearing a dosimeter while working	never	197(97)	109(96.5)	0.74	102(98.1)	204(96.2)	0.5
	sometimes	6(3)	4(3.5)		2(1.9)	8(3.8)	
	always	0(0)	0(0)		0(0)	0(0)	
Attitude score 30[28;32] ¥		29[28;31] ¥	31[29;33] ¥	<0.0001*	31[29;33] ¥	29[28;31] ¥	<0.0001*

G.D.P: General Dental Practitioner
 PDHS:Public Dental Health Service
 PP:Private Practice
 ¥: med[Q1; Q3]
 *: Significant at P < 0.05.

Table2: Social demographic and professional characteristics of participants with dental radiation protection Attitudes (Univariate and Multivariate analysis).

Characteristics	RP Attitudes					
	Univariate analysis			Multivariate analysis		
	OR	95%	P-Value	OR	95%	P-Value
Gender						
Male	ref					
Female	1.26	[0.61;2.6]	0.52			
Age (years)						
≤29	ref					
30-39	0.46	[0.19;1.09]	0.07			
40-49	0.74	[0.29;1.91]	0.53			
≥50	1.20	[0.43;3.35]	0.72			
Years of experience (years)						
<5	ref					
05-10	1.83	[0.85; 3.94]	0.12			
11-20	1.24	[0.51; 3.02]	0.62			
>20	1.11	[0.39; 3.13]	0.84			
Dentist Qualification						
GDP	Ref			ref		
specialst	3.01	[1.51; 5.96]	0.002*	2.90	[1.28; 6.55]	0.01*
Workplace setting						
PDHS	ref					
PP	0.46	[0.23; 0.91]	0.026*			
RPC Training						
Yes	ref					
No	1.30	[0.66; 2.56]	0.44			

RP: Radiation Protection

G.D.P: General Dental Practitioner

PDHS:Public Dental Health Service.

PP:Private Practice

RPC Training:Radiation Protection Continuous Training

OR: Odds Ratio

*:Significant at P<0.05.

In contrast An et al., and Yurt et al., reported that 57% and 88.9% respectively of their studies' participants used it. In Morocco, Routine personnel radiation monitoring among dentists is not mandatory. According to the obtained results, no significant difference in terms of attitudes on radiation protection was observed according to the gender, age and years of professional experience ($p=0.45$; $p=0.80$ and $p=0.46$ respectively) which approximate results of Binnal et al. [29]. The result of this study revealed that the attitude scores of dental specialists was significantly higher than that of general dental practitioners. The same finding was reported by Kamran et al. and in contrast with results presented by Yurt et al. In a further finding, the attitude score of dentists in Public Dental Health Service (PDHS) was significantly higher than that of dentists in private practice [22,30]. These results are in line with those reported by Binnal et al. and in opposition to results reported by Kamran et al. [29]. The result of multivariate logistic regression analysis showed that dentist qualification (OR= 2.90 and $p= 0.01$) was significant predictor of Attitude. In study done by Alavi et al., the result

of the linear regression analysis demonstrated that in-service training significantly predicted radiation protection attitude [30]. This study has some limitations, one of which was that the majority of participants were general dentists and mostly worked in private practice. On the other hand, memory and idealization issues encountered due to the nature of such studies may also limit the study results. Therefore, qualitative observational studies may be more useful for understanding and exploring in depth dentists' attitudes to radiation protection.

5. Conclusions

The results of this study indicated that the majority of Moroccan dentists were less attentive to good radiation protection practices and procedures, particularly when prescribing x-rays, explaining the risks and benefits of radiation protection and adopting appropriate radiation protection tools. The radiation protection attitude was associated with dentist's qualification and workplace setting. Therefore, it is strongly advised that dentists be trained and

reinforced to maintain a positive attitude towards radiation protection safety.

References

- [1] A. G. Lurie, & M. L. Kantor. (2020). Contemporary radiation protection in dentistry: recommendations of National Council on Radiation Protection and Measurements Report No. 177. *The Journal of the American Dental Association*. 151 (10): 716-719.
- [2] R. Jacobs, M. Vanderstappen, R. Bogaerts, & F. Gijbels. (2004). Attitude of the Belgian dentist population towards radiation protection. *Dentomaxillofacial Radiology*. 33 (5): 334-339.
- [3] E. Abuelhia, A. Alghamdi, A. Tajaldeem, O. Mabrouk, A. Bakheet, H. Alsaleem, ... & R. Aljondi. (2022). Dental Undergraduates and Interns' Awareness, Attitudes, and Perception of Radiological Protection. *International Journal of Dentistry*.
- [4] International Atomic Energy Agency. (2022). Radiation protection in dental radiology, safety reports series No. 108, IAEA, Vienna. Available from: https://www-pub.iaea.org/MTCD/Publications/PDF/PUB1972_Web
- [5] F. M. Rusch, M. M. Bornstein, & D. Dagassan-Berndt. (2022). The use of protection measures in dento-maxillofacial radiology in Europe: a survey among experts. *Swiss Dental Journal*. 133 (1).
- [6] A. Memon, S. Godward, D. Williams, I. Siddique, & K. Al-Saleh. (2010). Dental x-rays and the risk of thyroid cancer: a case-control study. *Acta oncologica*. 49 (4): 447-453.
- [7] M. A. Han, & J. H. Kim. (2018). Diagnostic X-ray exposure and thyroid cancer risk: systematic review and meta-analysis. *Thyroid*. 28 (2): 220-228.
- [8] S. Y. Hwang, E. S. Choi, Y. S. Kim, B. E. Gim, M. Ha, & H. Y. Kim. (2018). Health effects from exposure to dental diagnostic X-ray. *Environmental health and toxicology*. 33 (4).
- [9] S. Y. An, K. M. Lee, & J. S. Lee. (2018). Korean dentists' perceptions and attitudes regarding radiation safety and protection. *Dentomaxillofacial Radiology*. 47 (xxxx): 20170228.
- [10] R. C. Gillies, C. Quiñonez, R. E. Wood, & E. W. Lam. (2021). Radiograph prescription practices of dentists in Ontario, Canada. *The Journal of the American Dental Association*. 152 (4): 284-292.
- [11] P. Yalçın, M. Ekinçi, & S. A. Yalçın. (2020). Radiation Attitudes Scale for Health Care Staff. *European Journal of Physics Education*. 11(3): 17-37.
- [12] S. Park, & Y. Yang. (2021). Factors affecting radiation protection behaviors among emergency room nurses. *International Journal of Environmental Research and Public Health*. 18(12): 6238.
- [13] S. Park, & Y. Yang. (2021). Factors affecting radiation protection behaviors among emergency room nurses. *International Journal of Environmental Research and Public Health*. 18(12): 6238.
- [14] Y. Martínez-Beneyto, F. Camacho-Alonso, M. Alcaraz-Baños, P. López-Jornet, & L. Perez-Lajarin. (2008). Spanish dental hygienist attitudes to dental radiological protection: assessment of a 1-day pilot course. *International journal of dental hygiene*. 6(1): 13-18.
- [15] S. Shahab, A. Kavosi, H. Nazarinia, S. Mehralizadeh, M. Mohammadpour, & M. Emami. (2012). Compliance of Iranian dentists with safety standards of oral radiology. *Dentomaxillofacial Radiology*. 41(2): 159-164.
- [16] S. Kaur, A. Sinha, & M. Sangral. (2020). Knowledge, attitude and practice of dentists about radiation protection in Jammu. *Journal of Advanced Medical and Dental Sciences Research*. 8(4): 16-18.
- [17] W. Al Faleh, A. Bin Mubayrik, S. Al Dosary, H. Almthen, & R. Almatrafi. (2020). Public perception and viewpoints of dental radiograph prescriptions and dentists' safety protection practice. *Clinical, Cosmetic and Investigational Dentistry*. 533-539.
- [18] B. D. Lee, & J. B. Ludlow. (2013). Attitude of the Korean dentists towards radiation safety and selection criteria. *Imaging science in dentistry*. 43(3): 179-184.
- [19] K. Horner. (2013). Radiographic selection criteria: new guidelines, old challenges. *British Dental Journal*. 214(4): 201.
- [20] K. Horner, & K. A. Eaton. (Eds.). (2013). Selection criteria for dental radiography. Faculty of General Dental Practitioners, Royal College of Surgeons of England.
- [21] A. K. A. Y. Gülsün, M. Özdede, & Ö. KARADAĞ. (2022). Informed Consent in Dentomaxillofacial Radiology: A Cross-Sectional Study. *Clinical and Experimental Health Sciences*. 12(3): 683-690.
- [22] A. Yurt, C. Ayrançioğlu, G. Kılınç, & E. Ergönül. (2022). Knowledge, attitude, and behavior of Turkish dentists about radiation protection and radiation safety. *Dentomaxillofacial Radiology*. 51(1): 20210120.
- [23] H. G. Shah, S. Patel, K. Patel, V. Patel, V. Sodani, & S. Savant. (2014). Knowledge and practices of interns, graduates and post-graduates of Ahmedabad dental college and hospital, Ahmedabad, Gujarat regarding radiographic protection. *International Journal of Health Sciences and Research*. 2: 787-91.
- [24] V. S. Asha, R. Krupashankar, A. P. Kavitha, R. Shobha, & M. J. Jijin. (2015). Awareness towards radiation protection measures among dental practitioners in Coorg district: A questionnaire study. *International Journal of Dental and Health Sciences*. 2(6): 1460-1465.
- [25] I. R. Ihle, E. Neibling, K. Albrecht, H. Treston, & A. Sholapurkar. (2019). Investigation of radiation-protection knowledge, attitudes, and practices of North Queensland dentists. *Journal of investigative and clinical dentistry*. 10(1): e12374.

- [26] O. W. Linton, & F. A. Mettler Jr. (2003). National council on radiation protection and measurements. In National conference on dose reduction in CT, with an emphasis on pediatric patients. *AJR. American journal of roentgenology*. 181 (2): 321-329.
- [27] A. Shetty, F. T. Almeida, S. Ganatra, A. Senior, & C. Pacheco-Pereira. (2019). Evidence on radiation dose reduction using rectangular collimation: a systematic review. *International dental journal*. 69(2): 84-97.
- [28] A.Binnal, G. Rajesh, C. Denny, J. Ahmed, & V. Nayak. (2013). Insights into the state of radiation protection among a subpopulation of Indian dental practitioners. *Imaging science in dentistry*. 43(4): 253-259.
- [29] R. Kamran, K. Saba, & S. Azam. (2022). Knowledge & Practice of Radiation Exposure Protection Protocols by Dentists Performing Endodontic Treatment in Pakistan. *European Journal of Dental and Oral Health*. 3(1): 27-32.
- [30] S. S. Alavi, S. T. Dabbagh, M. Abbasi, & R. Mehrdad. (2017). Medical radiation workers' knowledge, attitude, and practice to protect themselves against ionizing radiation in Tehran Province, Iran. *Journal of education and health promotion*. 6.