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Assessment of Saudi dentists' awareness of and adherence to radiation protection measures

Salma Hamed Alshamrani[1], Saber Hamoud Al Shibani[2], Sameera Musif Salem Alharbi[3], Alanoud Fahad Abdullah Bin Muammar[4], Hani Abduqadir Labban[5], Tithkar Abdullah Mohammed Alshanqiti[6], Alsabai, Gasim Mohsen A[7], Boshra Ebraheem Mofareh Al wagdi[8], Aishah A B Hawsawe[9], Ebraheem Abdulaziz Aljarboa[10]

1 Registrar-Family Dentistry, AlBaha Health Cluster, Saudi Arabia.
2 Radiology Technologist, Children Hospital Taif, Saudi Arabia.
3 XRAY TECHNICIAN, Al-Safiah Urgent Care Center, Saudi Arabia.
4 General Dentist, AlBaha Health Cluster, Saudi Arabia.
5 X-ray tech, Makkah MOH, Saudi Arabia.
6 Technician-Radiological Technology, King Abdullah medical Complex-Jeddah, Saudi Arabia.
7 X-ray TECH, Jazan health cluster, Saudi Arabia.
8 Radiological Technology, Aseer central Hospital, Saudi Arabia.
9 Technician-Radiological Technology, Maternity and Children's Hospital - Mecca, Saudi Arabia.
10 X-ray tech., Alrass general hospital, Saudi Arabia.

Abstract :
Background: Ionizing radiation is widely employed in dentistry and other medical diagnostic and therapeutic treatments. As a result, dentists are among the occupational categories that are regularly exposed to ionizing radiation.
The purpose of this study is to evaluate dentists' **radiation protection measures**, attitudes, and knowledge. **Methods**: 271 dentists employed by the Jeddah Medical City as well as other private clinics and facilities in Jeddah, Saudi Arabia, participated in a cross-sectional study using questionnaires. Convenience sampling was used to choose participants, and a self-administered structured questionnaire was used to gather data.
Findings: Radiation hazards and safety knowledge scores ranged from 3 to 16, with a median of 11 and a mean of 11.05 ± 2.56. Additionally, three quarter of dentist possessed good knowledge, while only one quarter lacked it. Furthermore, In terms of dentists' compliance with radiation safety protocols while in practice, 49.1%, 41.3%, 49.4%, 38.4%, and 45.8% of the dentists in the study stated that they frequently or very frequently stand behind a lead barrier when exposed to X-rays, wear lead aprons, stand six feet away from the main X-ray beam, hold or display warning signs while exposed to X-rays, and permit people to enter the room while exposed to X-rays, respectively
Conclusion: almost 75% of the dentists polled knew a lot about radiation safety and risks. The results do, however, point to gaps in some knowledge and practice, with many dentists voicing doubts on the lucidity of safety protocols at work. It is advised to establish a required, continuing education program for dentists that focuses on radiation hazards and the most recent safety procedures, given the constant exposure to radiation in their line of work.

Introduction :

In clinical dentistry, radiographs are the most frequently ordered test during the initial examination and are an essential component of the diagnostic process.1 Given the large lifetime prevalence and frequency of dental X-rays, any elevated health risk linked with these exams would be of significant public health concern, even if radiation doses from these exams are generally low. 2. No radiation exposure may be regarded as risk-free in light of this. The dangers associated with cumulative doses should not be undervalued, even if the chance of developing a primary cancer as

a result of exposure during routine dental radiography is thought to be minimal. Since their teeth and dentition are still growing and their risks are higher, I focused more on children and young adults.5. Dental radiography has the potential to be hazardous even with its beneficial results. 4.
It has been linked to a higher risk of thyroid cancer in a number of studies.6,7 Hwang et al.8 underlined that cumulative exposure to low-dose radiation from dental X-rays cannot be ruled out or disregarded and provided evidence of an elevated risk of head and neck cancer as a result of low-dose dental X-ray exposure in a comprehensive review.
Radiation therapy and diagnosis are common uses for ionizing radiation (1). Therefore, to guarantee the avoidance of any potentially detrimental consequences among healthcare personnel, the understanding of radiation safety and biological impacts of radiation should be assessed and eventually improved upon (2). One occupational group that is regularly exposed to ionizing radiation is dentists. More radiographs are used by dentists than by any other medical professional (3). Radiographs are exposed, processed, and interpreted by the practicing dentist for diagnosis, treatment monitoring, and lesion development (4). Therefore, dental clinics are increasingly installing radiography equipment and cone-beam computed tomography (CBCT) (5). A number of exposure characteristics, including collimation, digital or film-based imaging, film speed, method, and protective barriers used, affect the radiation dose that the patient or operating dentist receives during dental radiography (6). Ionizing radiation's impact on health can be divided into two categories: deterministic and stochastic. When a certain exposure threshold is surpassed, the dose-dependent deterministic effect occurs. Heritable effects and cancer are examples of stochastic effects that have a dose-dependent probability and arise from DNA damage at a level that has no threshold (7). Despite the modest radiation dose from dental radiography, there is a significant chance of stochastic effects for both the patient and the dentist. Therefore, reducing occupational exposure to ionizing radiation is essential in order to prevent the cumulative dosage that patients and dentists will get during their lifetime (8). All measures aimed at reducing radiation exposure for patients and staff with the intention of minimizing its negative consequences are generally referred to as radiation protection (6). According to the International Atomic Energy Agency (IAEA), patient exposure should be justified and limited to what is required to meet the intended goal or diagnostic. 5. Therefore, in order to prevent any needless radiation exposure, the dentist's daily activity must adhere to the ALARA (as low as reasonably possible) approach. Dental professionals must have the proper knowledge and training in order to protect themselves against occupational radiation, and the right tools and equipment must be available. Additionally, the International Commission on Radiological Protection (ICRP) principles of dose limitation, protection optimization, and justification are implemented to achieve occupational radiation protection. This necessitates that the dentist be well-versed in the dangers of ionizing radiation and how to prevent them (7,9). a result, everyone working in a dental office—not just the equipment operator—needs to understand the dangers of using X-ray equipment, the steps needed to keep their dose ALARA, and how crucial it is to follow these agreements.10.
Every day in their practice, dentists use X-rays. Their behavior and understanding regarding the X-ray examination can affect both their own and the patients' radiation exposure. Dentists must follow the guidelines and standards of radiation protection and safety in order to reduce and mitigate the hazards related to the use of ionizing radiation in dentistry. Nonetheless, a number of research on dental professionals have revealed that their behavior and awareness of radiation safety are lacking.3, 11, and 13.
In the meantime, Panwar et al. (2022) demonstrated in their study that the majority of Indian dentists frequently overlook the correct application of radiation protection protocols. These results

suggest that there are notable gaps in radiologic safety practices, attitudes, and knowledge. emphasizing the need for improved training, education, and awareness campaigns focused on biological hazards and radiologic safety in dentistry settings. In order to assist dentists working in the radiation field in effectively protecting themselves and their patients, it is necessary to evaluate their knowledge, attitudes, and practices (KAP) on radiation safety. It should be mentioned that there is a dearth of published information on dental practitioners' KAP with reference to radiation safety. Thus, the goal of the current study was to evaluate the knowledge, attitudes, and practices of dentists regarding radiation protection .

Methods :

Research Design

It was a cross-sectional study. The period of data gathering in 2024 was May through July.

Population and Study Setting

The study was conducted on dentists employed by Jedah Medical City as well as private clinics and facilities in Jeddah, Saudi Arabia.The study's inclusion criteria covered both male and female dentists. The study included dental specialists, general practitioners, and postgraduate students.

Sampling Method and Sample Size

The sample size was determined. A sample size of 300 dentists was determined. A 10% non-response rate was added, increasing the sample size to 280 participants overall. A 97% response rate was represented by the 270 dentists that made up the sample size. Convenience sampling was used to find dentists for this study.

Instrument for Gathering Data

A standardized, self-administered questionnaire was used to gather data. The questionnaire's questions were taken from earlier research (6, 10–16). The anonymous, English-language questionnaire was filled out voluntarily. Sociodemographic information such as sex, age, marital status, place of residence, current employment, and years of experience were among the primary components of the questionnaire. Knowledge of radiation safety, which includes 16 questions about exposure precautions and radiation's negative health impacts. A score of one was awarded for each right answer, while a score of zero was awarded for any incorrect or unclear answers. Dentists' knowledge was categorized as poor if their score was below 60% and good if their score was above 60%, with a cut-off point of 60% (16).

Attitude toward radiation safety: It asked about their thoughts and sentiments on radiation safety precautions and surveillance in the workplace. A three-point Likert scale from 3 (agree) to 1 (disagree) was used to score questions about safe working practices; a higher score indicated a positive attitude, while a lower score indicated a negative attitude. Radiation safety practice: The items in this area dealt with how radiation safety was applied in their profession.

The questionnaire was created in English, and two experts—one in occupational health and the other in dental radiology—reviewed it to make sure it addressed the study's goals in order to evaluate its face and content validity. Ten dentists participated in a pilot study to examine the questionnaire's viability and language clarity. As a result, we eliminated two questions and modified two others. The final analysis did not include data from the pilot research. The reliability of the questionnaire was demonstrated by the derived Cronbach's alpha coefficient, which was 0.78.

statistical analysis

Software called SPSS 23.0 was used to evaluate the data that was gathered. Frequencies and percentages were used to describe descriptive data and demographic features. Pearson To compare the data, the chi-square test was employed. The answer options "public," "semi-public," and

"private" were merged into two categories by combining "public" and "semi-public" in instances where the distribution of responses was highly uneven. Shapiro-Wilk statistics were used to verify that the data was normal. The Mann Whitney U test and Kruskal-Wallis non-parametric statistical tests were employed. The Spearman correlation test was used to determine the link between dental radiation protective practices and knowledge.

There were 271 participants in this study, including dentists. Women made up over half of the respondents (52.8%). Of the participants in the study, 120 (44.3%) were between the ages of 25 and 35. Of the dentists who were included, over half (56.1%) were married. The mean number of years of work experience was 11.40 ± 7.05 years, with a range of 1 to 39 years (Table 1).

Table 1. Sociodemographic data of studied dentists

Sociodemographic variables	Dentists (n=271) No. (%)
Sex	
Male	128 (47.2)
Female	143 (52.8)
Age Category	
25-	120 (44.3)
35-	85 (31.4)
45-	51 (18.8)
55-65	15 (5.5)
Marital status	
Unmarried	119 (43.9)
Married	152 (56.1)
Current job	
General practitioner	141 (52.0)
Postgraduate student	54 (19.9)
Specialist	76 (28.0)
Years of experience	
mean ± SD	11.40 ± 7.05
Median (Range)	10 (1-39)

Of the participants who were included, 89% of dentists recalled that dental X-rays are detrimental, and 56.2% said that X-rays had hazardous effects. Of the participants, 58.5% knew that X-rays could be reflected from the room's walls, and less than half knew that X-rays have harmful and random consequences. Nearly half of participants knew the radiation hazard symbol, indicating their awareness of radiation safety precautions. Furthermore, 62.4% of respondents indicated that they were aware of the precautions to be taken when utilizing an X-ray machine. Furthermore, the ALARA (as low as reasonably feasible) criterion was mentioned by 62.4% of respondents.

Nonetheless, 195 participants were able to properly identify ALARA's entire form. The NCRP (National Council on Radiation Protection and Measurement) and ICRP (International Commission on Radiological Protection) recommendations were unfamiliar to 78.2% of the dentists who were included, in contrast to ALARA awareness. Additionally, almost 50% of participants accurately recognized that 6 The best distance for an operator to stand during dental radiography exposure is between 90° and 135°. Both 64.9% and 63.5% of participants accurately said that the operator should wear a personal monitoring badge and that high speed films limit exposure. 63.5% of participants said that the operator should wear personal monitoring badges. Ninety percent of dentists correctly answered that radiation exposure is decreased by lead aprons with shields and exposure duration. Furthermore, 55% of the dentists in the study properly selected 5.0 rems/year as the maximum allowable dose for occupational exposure, and 38% of them correctly selected 3 months as the minimum exposure length for employing personnel monitoring equipment (Table 2).

Table 2. Knowledge of studied dentists regarding radiation safety Dentists' correct answers (n=271)

Knowledge variables	No. (%)
If dental X-ray is harmful	89

Awareness of hazardous effect of X-ray	58.2
Awareness of detrimental and stochastic effects of X-ray	42.4
If X-ray can be reflected from the walls of the room	56.
Awareness of the radiation hazard symbol	45.8)
Awareness of the protection measures during using X-ray machine	60.5)
Awareness of ALARA (as low as reasonably achievable) principle	62.4)
Awareness of full form of ALARA	72.
Awareness of NCRP (National Council on Radiation Protection and Measurement) /ICRP (International Commission on Radiological Protection) recommendations	25.9
Ideal distance that operator should stand during dental radiographic exposure	54.6
If high speed films reduce exposure	68.9
If the operator should wear personal monitoring badges	3.5
Awareness of options that reduce radiation exposure	80.4)
If digital radiography differs than conventional radiography in the harmful effects	66.5)
Minimum exposure duration for using personnel monitoring devices	38
Maximum permissible dose for occupationally exposure	59

Radiation hazards and safety knowledge scores ranged from 3 to 16, with a median of 11 and a mean of 11.05 ± 2.56. Additionally, three quarter of dentist possessed good knowledge, while only one quarter lacked it (Figure 1).

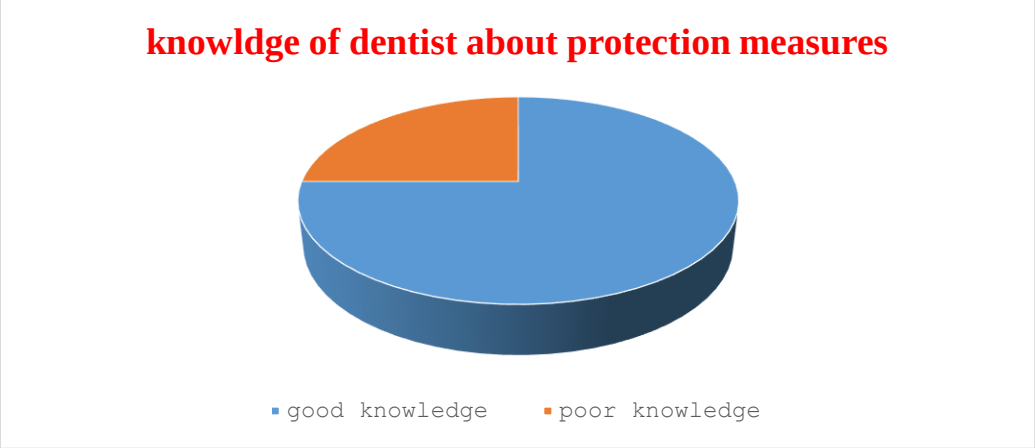


Figure 1 frequancy distribution of knowledge regarding protection practices

Regarding the study's participants' attitudes toward workplace radiation safety, 157 dentists (57.9%) disagreed that radiation precautions policies and procedures are clear and easy to understand, and 57.9% disagreed that workplace radiation protection policies and procedures are based on existing regulations. Furthermore, compared to 22.9% who agreed, 55.7% of the dentists in the study said they disagreed about feeling comfortable when providing radiation precautions to patients. Furthermore, a greater proportion of individuals (53.9% and 12.9%, respectively) expressed uncertainty about their radiation exposure monitoring than did those who felt confident. Nonetheless, 43.5% of respondents concurred that it's critical to use collimators and filters when doing dental radiography (Table 3).

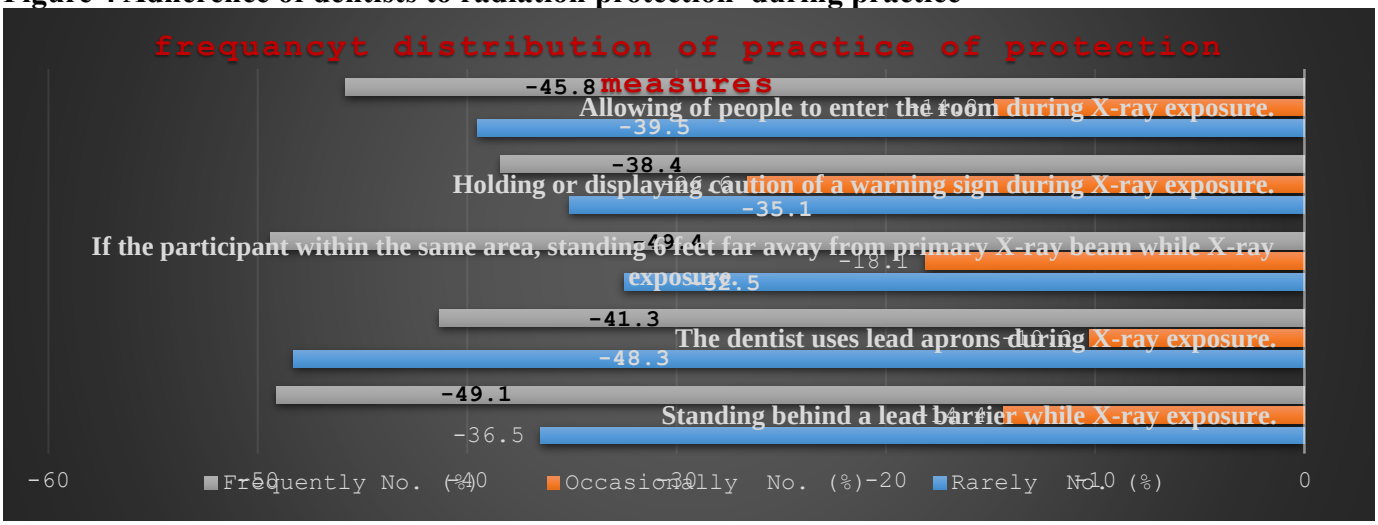
Table 3. Attitude of studied dentists about radiation safety (n=271)

Attitude questions	Disagree No. (%)	Neutral No. (%)	Agree No. (%)
The Policies and procedures of radiation precautions are easy to understand and clear.	(60)	28	15
I feel in the workplace that policies and procedures related to radiation protection are established on current regulations.	58	75	(14.4)
I feel confident about steps that need to be taken when caring for patients requiring radiation precautions.	(55.7)	(21.4)	(22.9)
I feel safe while caring for patients requiring radiation precautions.	(57.2)	(20.7)	(22.1)
I feel confident regarding my radiation exposure monitoring.	(53.9)	(33.2)	(12.9)
Using collimators and filters in dental radiography is important.	(38.0)	(18.5)	(43.5)

In terms of practice, 73 dentists (63.8%) stated that they had attended introductory lectures on radiation exposure. Furthermore, 43.9% of respondents said they perform X-ray equipment maintenance, 53.5% said they perform yearly maintenance on the X-ray machine, and 33.2% said their dentist office has a radiation safety handbook. Nonetheless, 60.5% of respondents stated that they are exposed to radiation multiple times daily. Of the participants, 105 (53.5%) said they always use the dentist's hands to adjust the X-ray tube. Additionally, 47.2% of the dentists in the study stated that they utilize D film speed for periapical radiography, and 58.3% acknowledged that they employ lead aprons and gypsum wallboard to create a safe environment for X-ray exposure.

Figure 3 showed that In terms of dentists' compliance with radiation safety protocols while in practice, 49.1%, 41.3%, 49.4%, 38.4%, and 45.8% of the dentists in the study stated that they frequently or very frequently stand behind a lead barrier when exposed to X-rays, wear lead aprons, stand six feet away from the main X-ray beam, hold or display warning signs while exposed to X-rays, and permit people to enter the room while exposed to X-rays, respectively

Figure 4 Adherence of dentists to radiation protection during practice



Discussion :

In order to ensure the proper use of dental X-rays and reduce potential risks to patients and dental workers, it is essential to evaluate dentists' knowledge, attitudes, and practices regarding radiation hazards and safety. Therefore, the goal of the current study was to shed light on dentists' attitudes, knowledge, and behaviors regarding radiation safety and dangers. According to the study's findings, over three-quarters of the dentists in the sample knew a lot about this topic. This indicates that a sizable percentage of dentists possess a comprehensive awareness of radiation safety procedures, which is crucial for safeguarding patients and medical personnel. This result was consistent with research from Saudi Arabia and Nigeria that showed dentists were highly knowledgeable of radiation safety and risks, with reported percentages of 75.7% and 77.6%, respectively (17,18). However, this outcome was less than that of a study carried out at several public and private dental clinics in Taif City, Kingdom of Saudi Arabia, which found that 97.4% of dentists had good awareness about radiation safety and dangers (11). Even while our survey shows a comparatively high percentage of knowledge, it is crucial to remember that there is always space for improvement. This result suggests that approximately 25% of the dentists polled could need more instruction or training in radiation safety and dangers.

There are a number of reasons for the discrepancy in reported rates, including as variations in study samples, methods, and knowledge assessment criteria, training standards, and cultural and healthcare system variations. In terms of dentists' awareness of the dangers of dental X-rays, a resounding 87.5% answered in the affirmative. This suggests a comparatively high degree of awareness about the possible risks of radiation among the dental community. An Egyptian study by Arnout (2014) and a Saudi study by Ahmed et al. (2023) found that 87.5% and 86% of dentists, respectively, were generally aware of the dangers of dental X-rays.

Furthermore, a significant finding of this study is that roughly half of the participants (54.2%) acknowledged that X-rays can have direct or indirect effects on somatic or genetic cells. This was less than the percentage of participants in a study carried out in Egypt, which was 69.9% (10). The fact that less than half of the dentists (42.1%) demonstrated knowledge of the harmful and random consequences of X-ray radiation, however, is alarming. On the other hand, earlier research in Saudi Arabia and India showed that 78.2% and 98.4% of dentists, respectively, were aware of these consequences (11,12). Furthermore, 45.8% of the participants said they were less aware of the radiation hazard emblem, which serves as a visual alert for possible This ignorance could lead to accidental exposure or inadequate safety precautions. An essential idea in radiation safety is the ALARA principle. In contrast to the earlier study by Lawani et al. (2023), which reported a greater proportion of familiarity among dentists in Nigeria (76.8%), our results show that 62.4% of dentists were familiar with this principle (17).

On the other hand, according to Ahmed et al. (2023), Yurt et al. (2022), and Arnout (2014), the ALARA principle was only known by 37.1% of Saudi dentists, 53% of Turkish dentists, and 33.3% of Egyptian dentists (18,19,10). However, it was discovered that over a quarter (25.8%) of the dentists polled were aware of the radiation safety regulations and guidelines offered by the NCRP or ICRP recommendations. The findings of this study are in line with those of a study conducted in Nigeria (18) and Egypt (10), which found that only 19.5% and 25% of dentists, respectively, knew enough about the NCRP and ICRP recommendations.

Additionally, our study showed that over half of the participants knew that the optimal distance for an operator to maintain during dental radiography exposure is six feet from the x-ray source and at a position that is greater than a straight angle (90–135°) to the primary beam. The results of the current study, on the other hand, were higher than those of a previous Nigerian study (22%) and

lower than those of a study conducted in India, where 95.2% of participants had similar knowledge (12). Our study demonstrates that more than half of the dentists polled were able to differentiate between digital and conventional radiography in terms of negative consequences, which is consistent with earlier research conducted in Nigeria, Saudi Arabia, and Turkey (17–19). This result suggests that the dental staff is reasonably aware of the benefits of digital radiography, which typically entails lower radiation doses than traditional film-based methods. Additionally, about 50% of dentists stated that they are aware of the highest amount that can be exposed at work.

According to the current study, almost two-thirds of the participants have at some point attended a basic lecture on radiation exposure. This finding suggests that a sizable percentage of dentists have undergone rigorous radiation safety instruction or training. A possible weakness in the implementation of thorough safety measures is suggested by the study's finding that only one-third of dentists have a radiation safety plan in place. According to the survey, the majority of participants said they used their hands to adjust the X-ray tube. This is in good agreement with the findings of Panwar et al. (2022) (12), who found that 86.5% of dentists disregarded this technique and adjusted the tube with their hands. Additionally, almost 53% of participants in our survey reported utilizing E or F film speed for radiography. Similarly, earlier research in Turkey and India found that 56.3% and 35.7% of dentists, respectively, employed E-films in their clinics (12,19). According to this research, many dentists continue to use slower film speeds, which may expose patients to higher radiation dosages. It should be underlined that the following are priority suggestions that every dentist should fully understand: In addition to doing their utmost to get radiographs from previous clinical dental examinations, dentists should request radiographs depending on the requirements of diagnosis and treatment planning. Instead of using film for intraoral, panoramic, and cephalometric imaging, digital receptors should be utilized. Rectangular collimation is strongly recommended for intraoral imaging wherever possible. Only in cases when lower-exposure techniques cannot yield the required diagnostic information should cone-beam computed tomography be employed (23).

Conclusion:

According to the study's findings, dentists in practice still lack the knowledge and procedures necessary to uphold suitable radiation protective barriers and adhere to the ALARA principle. Nonetheless, increasing dentists' awareness of radiation protection instruments and procedures as well as dose reduction strategies may improve their safe practices. In summary, almost 75% of the dentists in the study knew a lot about radiation risks and precautions. Nonetheless, the study's conclusions point to gaps in certain dentists' understanding and procedures about radiation risks and safety. When it came to workplace safety, most of dentists had differing opinions. Therefore, it is advised that dentists participate in a required continuing education program that focuses on radiation safety and the most recent procedures

References :

- Goula A, Chatzis A, Stamouli MA, Kelesi M, Kaba E, Brilakis E. Assessment of health professionals' attitudes on radiation protection measures. Int J Environ Res Public Health. 2021 Dec 19;18(24): 13380. doi: 10.3390/ijerph182413380.
- Abuzaid MM, Elshami W, Hasan H. Knowledge and adherence to radiation protection among healthcare workers at operation theater. Asian J Sci Res. 2018;12(1): 54-59. doi: 10.3923/ajsr.2019.54.59

- Shahab S, Kavosi A, Nazarinia H, Mehralizadeh S, Mohammadpour M, Emami M. Compliance of Iranian dentists with safety standards of oral radiology. Dentomaxillofacial Radiology. 2012 Feb;41(2) :159-64. doi: 10.1259/dmfr/29207955.
- Praveen BN, Shubhasini AR, Bhanushree R, Sumsum PS, Sushma CN. Radiation in dental practice: Awareness, protection and recommendations. J Contemp Dent Pract. 2013 Jan 1;14(1):143-8. doi: 10.5005/jp-journals-10024-1289.
- Rozylo-Kalinowska I. Imaging techniques in rental radiology. 1st ed. Springer Cham. 2020.
- Swapna L, Koppolu P, Takarji B, Al-Maweri S, Velpula N, Chappidi V, et al. Knowledge on radiation protection & practice among dental students. Br J Med Med Res. 2017;19(7):1-7. doi: 10.9734/BJMMR/2017/30761
- Okano T, Sur J. Radiation dose and protection in dentistry. Japanese Dental Science Review. 2010 Aug;46(2):112-121. doi: 10.1016/j.jdsr.2009.11.004
- White S, Pharoah M. Oral radiology: Principles and interpretation. 5th ed. Mosby, St. Luis, USA. 2004.
- Do KH. General principles of radiation protection in fields of diagnostic medical exposure. J Korean Med Sci. 2016;31(1): S6-S9. doi: 10.3346/jkms.2016.31.S1.S6
- Arnout E. Knowledge, attitude and perception among Egyptian dental undergraduates, interns and postgraduate regard biological hazards and radiologic protection techniques: A questionnaire based cross-sectional study. Life Sci J. 2014;11(6):9-16.
- Ahmed R, Alshehri I, Alosaimi S, Musafer E, Abdullah R, Tail S, et al. Knowledge, attitude and practice of dentists toward oral radiology and radiation protection. Indian J Appl Res. 2019;9(7):23–9. doi: 10.36106/IJAR
- Panwar A, Gupta S, Nagaraju K, Malik S, Goel S, Sharma A. Awareness of radiation protection among dental practitioners in UP
- Kim IH, Singer SR, Hong DJ, et al. Fundamentals of radiographic interpretation for the dentist. Dent Clin. 2021;65(3):409–425. https://doi.org/10.1016/ j.cden.2021.02.001.
- Crane GD, Abbott PV. Radiation shielding in dentistry: an update. Aust Dent J. 2016; 61(3):277–281. https://doi.org/10.1111/adj.12389.
- Torresan TT, Rodrigues IC, Poletto MC, et al. Radioprotection in dentistry: knowledge and practices. Res Sov Dev. 2021;10(14). https://doi.org/10.33448/rsd- v10i14.22429.
- Khani T, Hasanzadeh H, Bitarafan-Rajabi A, et al. Assessment radiation protection: knowledge, attitude and practice in dental radiography staff. Front Biomed Technol. 2017;4(3–4):84–89.
- 5. International Atomic Energy Agency. Radiation protection in dental radiology. In: Safety Reports Series No. 108Vienna: IAEA; 2022.
- Memon A, Rogers I, Paudyal P, et al. Dental X-rays and the risk of thyroid cancer and meningioma: a systematic review and meta-analysis of current epidemiological evidence. Thyroid. 2019;29(11):1572–1593. https://doi.org/10.1089/ thy.2019.0105.
- Han MA, Kim JH. Diagnostic X-ray exposure and thyroid cancer risk: systematic review and meta-analysis. Thyroid. 2018;28(2):220–228. https://doi.org/10.1089/ thy.2017.0159.
- Hwang SY, Choi ES, Kim YS, et al. Health effects from exposure to dental diagnostic X-ray. Environ Health Toxicol. 2018;33(4):e2018017. https://doi.org/10.5620/ eht.e2018017.

- Chaudhry M, Jayaprakash K, Shivalingesh KK, et al. Oral radiology safety standards adopted by the general dentists practicing in National Capital Region (NCR). J Clin Diagn Res. 2016;10(1):ZC42–Z45. https://doi.org/10.7860/JCDR/2016/ 14591.708
- European Commission. Radiation Protection No. 136. European Guidelines on Radiation Protection in Dental Radiology. The Safe Use of Radiographs Dental Practice. Luxembourg: Office for Official Publications of the European Communities; 2004. http://ec.europa.eu/energy/nuclear/radiation_protection/doc/publication/ 136.pdf. [2022-11-18].
- Enabulele J, Igbinedion B. An assessment of dental students' knowledge of radiation protection and practice. J Educ Ethics Dent. 2013;3(2):54–59. https://doi.org/ 10.4103/0974-7761.136044.
- Yurt A, Ayrancıoglu C, Kılınç G, et al. Knowledge, attitude, and behavior of Turkish dentists about radiation protection and radiation safety. Dentomaxillofacial Radiol. 2022;51(1):20210120. https://doi.org/10.1259/dmfr.20210120.
- Almohaimede AA, Bendahmash MW, Dhafr FM, et al. Knowledge, attitude, and practice (KAP) of radiographic protection by dental undergraduate and endodontic postgraduate students, general practitioners, and endodontists. Int J Dent. 2020;2020: 2728949. https://doi.org/10.1155/2020/2728949.
- Amaoui B, Safini F, Lahlou L, et al. Physicians' knowledge about radiation protection of patients during prescription of CT scan procedures in Morocco. Radiat Med Prot. 2023;4(1):54–59. https://doi.org/10.1016/j.radmp.2023.02.004.
- Prasad M, Gupta R, Patthi B, et al. Imaging more imagining less: an insight into knowledge, attitude and practice regarding radiation risk on pregnant women among dentists of Ghaziabad - a cross sectional study. J Clin Diagn Res. 2016;10(7): ZC20–Z25. https://doi.org/10.7860/JCDR/2016/18153.8125.
- Basha SMA, BinShabaib MS, ALHarthi SS. Assessment of knowledge towards radiation protection measures among newly graduated dentists from Egypt and the Kingdom of Saudi Arabia: a questionnaire-based cross-sectional study. Dent J. 2022; 10(6):95. https://doi.org/10.3390/dj10060095.
- Sheikh S, Pallagatti S, Singla I, et al. Survey of dental radiographical practice in states of Punjab and Haryana in India. J Investig Clin Dent. 2014;5(1):72–77. https:// doi.org/10.1111/jicd.12016.
- Ousehal L, Lazrak L, Hassani K. Evaluation of stress among 100 Moroccan orthodontists. Open J Stomatol. 2011;1:1–6. https://doi.org/10.4236/ ojst.2011.11001.
- Ilgüy D, Ilgüy M, Dinçer S, et al. Survey of dental radiological practice in Turkey. Dentomaxillofac Radiol. 2005;34(4):222–227. https://doi.org/10.1259/dmfr/ 22885703.