

Public Perception and Viewpoints of Dental Radiograph Prescriptions and Dentists' Safety Protection Practice

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Purpose: The exposure of patients to ionizing radiation used in dentistry comes with a subtle risk of a stochastic effect, but there is tremendous benefit obtained from radiographic investigation for diagnosis, management, and monitoring of the treatment offered.

Aim: The aim of this study was to assess the viewpoint of the population concerning the prescriptions and practices in dentistry associated with dental radiographs and the safe use of ionizing radiation in dental clinics.

Patients and Methods: Validated and pretested structured self-administered questionnaires with 11 items were used. An electronic version of the questionnaire was created using Google Forms and distributed online through social media outlets. A total of 437 patients completed the questionnaire which contains questions about their demographic data and their perception of the practice of dentistry regarding hazard from dental radiographs. The collected data were analyzed statistically.

Results: Up to 88.6% of the study participants underwent dental radiography for various dental treatments. A majority of them relied on the dentist for the type of requested radiograph, 40% of them reported that dentist never explained the hazards associated with radiography. More than half of the participants (55%) never or hardly ever asked about safety measures before undergoing radiography. Most of the participants approved of radiography and never refrained.

Conclusion: There is a spectrum of perceptions by the population. Continuous patient education is recommended to enhance awareness regarding this matter. Community perception assists in correcting wrong beliefs and ensuring improvement.

Keywords: knowledge, radiation hazards, dental radiography, perception, safety and protection

Introduction

Human beings are constantly exposed to numerous kinds of ionizing radiation, both natural background radiation and artificial radiation. X-rays are one of the big families of ionizing radiations that are frequently used for therapeutic and diagnostic purposes in both medicine and dentistry. In dentistry, radiography plays a central role in diagnosis, planning for or managing pathological conditions in the oral and maxillofacial region. Despite the small amount of all radiation that comes from dental radiography, there is still some risk.¹

Patients during dental treatment are definitely exposed to diagnostic x-rays. Although the level of exposure is lower than that encountered in the medical

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field, the frequent exposure might carry an innate risk from radiation exposure that cannot be ignored. Biological hazards are classified based on probability of occurrence into deterministic and stochastic effects.² Deterministic effects are those effects in which the severity of the response is proportional to the dose; once the threshold dose reached the effect will occur in the exposed individual. On the other hand, stochastic effects develop at random and depend on the law of chance. There is no threshold dose, and even a minute dose could cause these harmful biological effects. Cancer and genetic mutations are examples of a stochastic effect in which the probability of occurrence increases with the degree of exposure to ionizing radiation, but the exposures do not influence the severity of the effect.² The importance of these effects has led the International Commission on Radiological Protection (ICRP) to introduce the “effective dose” concept as a measure of the risk from various radiographical evaluations.³

The effective dose was developed to measure the dose in relation to the possibility of induction of harm due to stochastic effects.⁴ The increased incidence of cancer in the head and neck area and health effects have been associated with the exposure to dental radiography as reported by some investigators.^{5–7}

In an attempt to determine the effective dose and safety from various types of dental radiography in the head and neck, several studies have been conducted to measure the effective dose from different kinds of intraoral and extraoral radiography and concluded that the effective dose exceeds that which was estimated previously.^{7,8} However, there is no clear evidence of the threshold dose beyond which patients are definitely exposed to risk from dental radiography. Thus, a reduction of the effective dose is recommended.^{7–9} The guiding concept is known as the “as low as reasonably achievable” (ALARA) principle, in which each patient should receive the correct imaging exam, at the right time, with the appropriate radiation dose.^{8–10}

Patients might have questions and concerns about safety during dental imaging procedures. Some of this information can be misleading, confusing, or incorrect; therefore, patients might refuse to undergo radiography based on the information they received via social media or the incorrect information they received from non-professional personnel. Moreover, patients might be unaware of the need for investigations by dentists to properly diagnose and treat the disease, which will affect the

outcome of the dental treatment. Only a few studies in the reviewed English literature have investigated the perception and views of the general population.¹¹ Thus, this study aimed to investigate the perception and viewpoints of a sample from the general population about the hazards of dental radiography and the practice of frequently requesting radiography in dentistry.

Materials and Methods

This cross-sectional study was designed and conducted to study the perception and viewpoints of the population regarding hazards associated with prescribed dental radiography and practice before any radiographic procedures. A structured self-administered questionnaire was designed based on the reviewed literature. The questionnaire was developed in Arabic in the form of multiple-choice questions on the hazards of ionizing radiation and protective measures used by dentists.

Before distributing the questionnaire through social media the institutional ethical committee approval was obtained, and a pilot study was first carried out on 40 participants with different characteristics to assess its clarity and feasibility. Participation in the study was voluntary.

The content of the questionnaire validated by oral radiologist before distribution to the population. The questionnaire consisted of three parts: the cover page with a consent form, request for cooperation, study explanation, importance, and instructions. The second part included socio-demographic questions such as age, gender, marital status, occupation, and level of education. It also had a part asking about the last dental visit, whether or not radiographs were taken or not and if the dental care center was private practice, governmental, or an academic institution. The third part was designed to assess the perception and attitude of participants toward the dental radiography prescription and x-ray using the Likert scale.

Statistical Analysis

The data were collected and analyzed, then summarized and presented in tables. All statistical analyses were performed with the Statistical Package for Social Sciences program (version 22). Descriptive statistics like frequency distributions were performed. *T*-tests were used to determine the association between previous radiographs and perception and attitude. The one-way ANOVA test and post hoc analysis were used to measure the relationship between level of education and perception with *P*-values ≤ 0.05 was considered statistically significant.

Results

A total of 437 completed questionnaires were received. More than half (58.1%) of the respondents were aged 40 or below. More than three-quarters (75.1%) of the sample had attained at least college level of education. More than half of the study participants (56.52%) were either unemployed or students; with the working-class individuals constituting the smallest group which represented 36.4% of the sample who are working in non-health-related sectors. The distribution of the socio-demographic characteristics of the participants is shown in Table 1.

Table 2 shows the perceptions and attitudes of the study participants toward different aspects of a radiographic prescription and practice by their dentist. More than half of the study population (51.7%) stated that they gave a history and underwent clinical examination are either often or always preformed before radiographs are taken. Moreover, almost 40% of the respondents indicated that their dentists never explained the hazards associated with radiography to them. However, almost one-third of the participants (28.4%) reported that they have never asked about radiographic safety measures. Furthermore, a majority of the dentists (67.2%) either always or frequently explained the results. A majority of the study participants did not abstain from radiography because of it is potential hazards.

Clinical examination and patient history before taking radiographs were significantly associated with age at $p = 0.043$. The Tukey's test indicated the most significant difference was between the 36–40 and 41–50 years age groups, with the latter were agreeing less that clinical history and examination was performed before radiography.

There was also a significant difference in the age groups regarding if radiation hazards were explained prior to obtaining radiographs or not. Tukey post hoc analysis showed that a significant difference exists between those in the 20–25 years age group and those in the 31–35 years age group. Similarly, students and singles agreed significantly more than governmental employee and married individuals about radiation hazards being explained to them, with P-values of $p = 0.009$ and $p = 0.012$, respectively. Respondents with previous radiographs were more to ask the dentist about radiation hazards was significantly associated with age ($p = 0.020$), previous radiographs ($p = 0.012$), and whether the individual being treated at governmental, private or teaching hospital ($p = 0.012$). The Tukey post hoc analysis

Table 1 Socio-Demographic Characteristics of the Sample

Variables	Gender	
	Male	Female
Age		
20–25	96 (22)	49 (11.2)
26–30	3 (0.7)	23 (5.3)
31–35	1 (0.2)	31 (7.1)
36–40	8 (1.8)	43 (9.8)
41–50	17 (3.9)	72 (16.5)
51 and above	26 (5.9)	68 (15.6)
Total	151 (34.6)	286 (65.4)
Marital Status		
Single	96 (22)	59 (13.5)
Married	54 (12.4)	204 (46.7)
Widow/divorced	1 (0.2)	23 (5.3)
Total	151 (34.6)	286 (65.4)
Education		
Primary/middle school	0 (0)	6 (1.4)
High school	19 (4.3)	32 (7.3)
Bachelor's degree	117 (26.8)	211 (48.3)
Post graduate degree	15 (3.4)	37 (8.5)
Total	151 (34.6)	286 (65.4)
Occupation		
Does not work	7 (1.6)	121 (27.7)
Student	90 (2.6)	29 (6.6)
Health care worker	13 (3)	18 (4.1)
Governmental employee/private/other	41 (9.4)	118 (27)
Total	151 (34.6)	286 (65.4)
Last Visit		
ER	35 (8)	46 (1.5)
Less than 6 months	46 (1.5)	120 (27.5)
6 to 12 months	24 (5.5)	51 (11.7)
More than a year	46 (1.5)	69 (15.8)
Total	151 (34.6)	286 (65.4)
Have You Received any Rad for Your Teeth Before?		
Yes	111 (25.4)	276 (63.2)
No	40 (9.2)	10 (2.3)
Total	151 (34.6)	286 (65.4)
Place of Taking Radiograph		
Hospital		
Gov	50 (11.4)	52 (11.9)
Private	95 (21.7)	218 (49.9)
Teaching	6 (1.4)	16 (3.7)
Total	151 (34.6)	286 (65.4)

indicated that significantly more respondents treated in teaching hospitals asked questions about hazards than those in private hospitals. The hazards were also explained to them significantly more ($p = 0.023$).

Table 2 Perception and Attitude of the Respondents Regarding Different Aspects of a Radiographic Prescription and Practice by Their Dentist

Variables	Never	Hardly Ever	Occasionally	Fairly Often	Always
	N (%)	N (%)	N (%)	N (%)	N (%)
Is the clinical examination and patient history checked before the dentist describes radiography?	50 (11.4)	58 (13.3)	103 (23.6)	102 (23.3)	124 (28.4)
Do you ask your dentist about radiation safety before taking it?	128 (29.3)	112 (25.6)	92 (21.1)	54 (12.4)	51 (11.7)
Is the radiation hazard explained before obtaining a radiograph?	174 (39.8)	133 (3.4)	72 (16.5)	37 (8.5)	21 (4.8)
Do you ask the dentist about the type of image (x-ray) before taking it?	124 (28.4)	123 (28.1)	97 (22.2)	43 (9.8)	50 (11.4)
Is the benefit explained before obtaining a radiograph?	68 (15.6)	86 (19.7)	102 (23.3)	105 (24)	76 (17.4)
Is the lead apron used during radiographic examination?	77 (17.6)	59 (13.5)	69 (15.8)	86 (19.7)	146 (33.4)
Is the thyroid gland (neck) covered during a radiographic examination?	130 (29.7)	93 (21.3)	92 (21.1)	54 (12.4)	68 (15.6)
Is approval taken before x-ray?	88 (2.1)	59 (13.5)	65 (14.9)	85 (19.5)	140 (32)
Does the dentist explain the results to you after taking the x-ray?	33 (7.6)	47 (1.8)	64 (14.6)	114 (26.1)	179 (41)
I refrain from radiation because of fear of its dangers	188 (43)	104 (23.8)	83 (19)	33 (7.6)	29 (6.6)
Is radiography routinely used by your dentist?	82 (18.8)	112 (25.6)	129 (29.5)	68 (15.6)	46 (1.5)

The level of education and marital status were significantly associated with the question related to the routine use of radiographs in the visited dental clinic ($p = 0.038$ and $p = 0.003$, respectively). Respondents who had attended high school agreed more than those with bachelor's degrees.

Participants with frequent dental visits (less than 6 months) agreed significantly more that lead aprons were used during radiation exposure than those who presented only for emergency treatments. The significant results are summarized in Tables 3 and 4.

Discussion

Radiation hazard is never considered zero, but when this procedure will benefit the treatment outcome, dentists have to ensure that the amount of radiation received outweighs the risk. The amount of radiation received by patients cannot be compared between individuals receiving

different treatments; however, the dose is dependent on the type of imaging and how frequently it is used by the dentist. This investigation was designed to explore the population perspectives about radiographic hazards, prescription, attitude, and anxiety in the dental clinics.

Diagnostic imaging is one of the elements of a large strategy plotted to treat patients successfully. Exposure of the patients to ionizing radiation used in dentistry carry a subtle risk of a stochastic effect that may lead to cancer or genetic mutations but there are tremendous benefits derived from radiographic investigations for diagnosis, management, and monitoring the improvement of treatments offered. Certain amounts of radiation are inevitably delivered to patients during dental treatment. Despite the indispensable role of imaging in dentistry, it still has the potential to cause harmful effects. However, there are dangers associated with the use of the various imaging modalities frequently used in

Table 3 T-Test of Analysis of the Association Between Previous Radiographs and Perception and Attitude

Variables		N	Mean	Std. Deviation	T	Sig. (2-Tailed)
Do you ask your dentist about radiation safety before taking it?	Yes	387	2.46	1.298	-2.517	0.012
	No	50	2.96	1.551		
Is the radiation hazard explained before obtaining a radiograph?	Yes	387	1.99	1.082	-4.387	0.000
	No	50	2.74	1.454		
Does the dentist explain the results to you after taking the x-ray?	Yes	387	3.87	1.246	2.250	0.025
	No	50	3.44	1.473		
I refrain from radiation because of fear of its dangers	Yes	387	2.04	1.169	-3.531	0.000
	No	50	2.68	1.518		

Table 4 Association of Sample Characteristics with Perception and Attitudes Using ANOVA Test

Variables			Sum of Squares	df	Mean Square	F	Sig.
Age	Is the clinical examination and patient history checked before the dentist describes the x-rays?	Between Groups	2.195	5	4.039	2.317	0.043
		Within Groups	751.448	431	1.743		
		Total	771.643	436			
	Is the radiation hazard explained before obtaining a radiograph?	Between Groups	17.699	5	3.540	2.712	0.020
		Within Groups	562.497	431	1.305		
		Total	58.197	436			
Education	Is radiography routinely used by your dentist?	Between Groups	12.708	3	4.236	2.829	0.038
		Within Groups	648.430	433	1.498		
		Total	661.138	436			
Occupation	Is the radiation hazard explained before obtaining a radiograph?	Between Groups	15.248	3	5.083	3.896	0.009
		Within Groups	564.949	433	1.305		
		Total	58.197	436			
Marital status	Is radiography routinely used by your dentist?	Between Groups	17.983	2	8.992	6.068	0.003
		Within Groups	643.154	434	1.482		
		Total	661.138	436			
	Is the radiation hazard explained before obtaining a radiograph?	Between Groups	11.705	2	5.852	4.468	0.012
		Within Groups	568.492	434	1.310		
		Total	58.197	436			
Last dental visit	Is the lead cap used during radiographic examination?	Between Groups	2.386	3	6.795	3.083	0.027
		Within Groups	954.315	433	2.204		
		Total	974.700	436			
Type of hospitals	Do you ask your dentist about radiation safety before taking it?	Between Groups	11.879	2	5.939	3.360	0.036
		Within Groups	767.275	434	1.768		
		Total	779.153	436			
	Is the radiation hazard explained before obtaining a radiograph?	Between Groups	1.038	2	5.019	3.821	0.023
		Within Groups	57.158	434	1.314		
		Total	58.197	436			

dental treatment. This danger is not comparable to the risk associated with other activities in daily life. In Saudi Arabia, the average dose the population was exposed to from natural background radiation was estimated by Al ammar in 2008, where he studied the amount of radiation from the soil in Riyadh and found that the annual effective radiation dose was calculated to be 0.14 mSv y⁻¹.¹²

A majority of the general population have access to dental information if they have concerns or doubts either through social media or websites of dental universities and hospitals, or private websites of dentists from different specialties. In the past, patients preferred to extract the tooth when they started to have pain due to several factors, among them their socio-economic status or difficulty accessing dental clinics.

However, these behaviors have been changed with increased education and awareness of the population and prefer to keep their teeth to maintain function and esthetics by seeking dental treatment for the restoration of decayed teeth or periodontitis or other craniofacial complications to lower the risk of tooth mortality and maintain a healthy dental status. This tendency of going for a preventive approach increases the frequency of use of ionizing radiation to optimize treatment outcomes.

After careful clinical examination and to formulate proper treatment plans, dentists frequently need further investigation to confirm their clinical findings by requesting various imaging modalities. With good practice, dentists must adhere to ALARA principles when requesting any imaging modalities it is recommended to use the lowest possible radiation doses required to produce the desired diagnostic image. In this study, the majority of respondents declared that clinical examination was conducted before performing any imaging modalities. Also, the dentist explained the result of the requested radiograph, which is the same finding reported by Purmal et al.¹³

Our investigation demonstrated that radiography is not used on a regular basis, but it will be requested depending on clinical need. This might also indicate the adherence of dentists to ALARA. Likewise, observing the relationship between the radiation dose and risk estimated for each imaging procedure and the benefit obtained from the radiographic image obtained.¹⁴

Although several methods of protection¹⁵⁻¹⁷ have been applied to reduce the radiation dose to patients, among them using digital or fastest films, use of lead aprons, use of rectangular collimators, adjustment of the exposure factor based on the task still required some concern from patients regarding the hazards of ionization radiation used in dentistry. In this study, more than half of the patients that never asked their dentist about the safety of procedures used. This could be attributed to the trust the patients had for their dentist. They believed that their dentists would never subject patients to unnecessary radiation that will not contribute to treatment or diagnosis. It could also be because the patients did not have any idea about these safety measures. Up to 70% reported that lead aprons were used before any radiographic procedures. In this study, we are not aware whether or not the lead aprons used by various dental clinics covered the thyroid gland to justify the 50% of participants that did not use the thyroid collar during radiographic examination. Also, panoramic radiography is the most requested radiograph by dentists. It is a frequently prescribed screening procedure by many dentists during initial visits. Thyroid collars are not

recommended in panoramic radiography since it will obscure the anterior area and lead to error and poor diagnostic images.

The perception of dental care by the population and safety protection methods implemented in the majority of dental clinics visited by the patients included in this study explained why the majority of the participants approved of radiographic procedures and never refrained from any procedure suggested by the dentist due to fear of dangerous effects of radiation.

Almost 40% of the respondents indicated that hazards were never explained to them by their dentists, which could be due to the limited time the dentist spent with the patients, or the fact that they concentrated on the treatment. Nevertheless, 4.8% of respondents reported that the dentist explained the hazards to them before taking radiographs. Therefore, dentist must educate the patients about the hazards of dental radiography and describe the benefit versus the risk, while reassuring the patients. If patients have any fear of exposure to dental radiation, the dentist has the responsibility to alleviate this fear.

In general, we cannot overemphasize the importance of the development of a good perception, and thus, acceptable awareness about the importance of imaging procedures to optimize the treatment outcomes. The dentist and oral radiologist must take some time to educate and inform patients about the hazards associated with x-ray and the different methods implemented to reduce these hazards. Scientific information regarding radiation doses delivered in dentistry might be disseminated improperly through the media to the public. With increased awareness of the population of the benefits of radiography, taking radiographs will improve the treatment outcome. In this study, 64.7% of the participant said that the dentist explained the benefit of taking radiographs, and this justified the use of specific procedures for specific tasks.

This investigation indicated that age, level of education, and marital status were associated with the perception of radiation hazards. Similarly, individuals treated in teaching hospitals were more prone to ask questions about the risks associated with radiography. Moreover, previous radiographs increase the concerns about the hazards associated with radiography. This is the first study to demonstrate such a relationship.

Overall, it seems that a reasonable percentage of participants' value dentists' practice of taking radiographs. Since a good percentage indicated a clinical screening, explanations of the clinical benefits, results, and obtaining the approval of patients before prescribing. Correcting the community perception assists in correcting wrong beliefs and ameliorating the practice of dentistry.

Conclusion

Our investigation revealed a reasonable perception and practice of dentists with respect to ionizing radiation. Yet, more emphasis needs to be laid on educating the population about hazards and protection, since perception was related to being exposed to dental radiography and several demographic variables. This might give the impression of perception built on experience.

Data Sharing Statement

Data are available and can be provided upon request.

Ethics Approval and Informed Consent

Ethical approval was obtained from Research Ethics Committee, Deanship of Scientific Research, King Saud University, Riyadh, Saudi Arabia. (IRB#E-20-4896CDRC No. FR0548235). Participation was voluntary, and written consent were obtained prior to contribution. This study was conducted in accordance with the Declaration of Helsinki.

Consent for Publication

We consent to that the details of any images, videos, recordings, etc. can be published, and that the persons providing consent have been shown the article contents to be published.

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Disclosure

The authors report no conflicts of interest in this work.

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