

## Insights into the state of radiation protection among a subpopulation of Indian dental practitioners

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### ABSTRACT

**Purpose:** Radiographs is an integral part of patient management in dentistry, despite their detrimental effects. As the literature pertaining to radiation protection among Indian dental practitioners is sparse, exploring such protection is needed.

**Materials and Methods:** All private dental practitioners in Mangalore, India were included in the study. A structured, pre-tested, self-administered questionnaire was employed to assess the knowledge, attitudes, practices, previous training, perceptions towards the need to spread awareness, and willingness to gain and implement knowledge about radiation hazards and protection. Information regarding each respondent's age, gender, education, and type and duration of practice was collected.

**Results:** Overall, 87 out of 120 practitioners participated in the study. The mean knowledge, attitude, and practice scores were  $9.54 \pm 2.54$ ,  $59.39 \pm 7.01$ , and  $5.80 \pm 3.19$ , respectively. Overall, 25.3% of the respondents had undergone training in radiation protection, 98.9% perceived a need to spread awareness, and 94.3% were willing to improve their knowledge. Previous training showed a significant correlation with age, sex, and duration of practice; attitude was significantly correlated with education and type of practice; and knowledge scores showed a significant correlation with type of practice.

**Conclusion:** Although the knowledge and practices of respondents were poor, they had a positive attitude and were willing to improve their knowledge. Age, sex, and duration of practice were associated with previous training; education and type of practice with attitude scores; and type of practice with knowledge scores. The findings of this study suggest a policy is needed to ensure the adherence of dental practitioners to radiation protection guidelines. (*Imaging Sci Dent* 2013; 43 : 253-9)

**KEY WORDS:** Radiation Protection; X-rays; General Practice, Dental; Demographic Factors

### Introduction

Since the discovery of X-rays in the year 1895, radiological examination has become an integral part of patient management in the field of dentistry. Though supplementary, radiographs play an indispensable role in the diagnosis, treatment planning, and follow-up of oral and maxillo-

facial disorders. However, the detrimental effects of X-rays on living tissues are as well appreciated as the beneficial effects.<sup>1-3</sup> Though the radiation doses encountered in dentistry are minimal, they entail stochastic effects, that is, an all-or-none phenomenon.<sup>4</sup> The prevailing approach is to keep the exposure to ionizing radiation as minimal as practically possible.<sup>4,5</sup> Various guidelines in dentistry protect patients, dental health professionals, and the environment from the harmful effects of ionizing radiation.<sup>6-8</sup>

In order to combat radiation-induced hazards, dental practitioners must adhere to these radiation protection guidelines. However, surveys conducted on practicing

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dentists have shown fairly little acceptance of these dose reduction techniques among dental practitioners.<sup>5,9-15</sup> Svenson et al have reported the knowledge, attitudes, and practices of Swedish dental practitioners regarding radiation protection.<sup>16-19</sup> Within the Indian context, Sheikh et al<sup>15</sup> reported poor radiation protection practices among their study subjects.

To optimize the implementation of radio-protective measures in dental practice, it is essential to identify factors that might influence effective radiation protection practices. In order to achieve this, various interactions of different issues related to radiation protection must be studied simultaneously in a single population. However, there is a dearth of comprehensive investigations into the various issues related to radiation protection, both globally and more specifically in the Indian setting.

Therefore, the present study aimed at assessing Indian dental practitioners' knowledge, attitudes, and practices with regard to radiation hazards and protection; previous training in low-dose practices; perceptions towards the need to spread awareness; and willingness to participate in events emphasizing radiation hazards and protection. The objective of the present study was also to explore interactions among the aforementioned variables and with respect to socio-demographic variables.

## Materials and Methods

The present study was conducted among private dental practitioners in the city of Mangalore, Karnataka, India. Ethical clearance was obtained from the Institutional Review Board, Manipal College of Dental Sciences, Mangalore, Manipal University. The investigators visited private dental practices in Mangalore, Karnataka, India, and the dental practitioners who were using ionizing radiation were included in the present study. The purpose of the study was explained to the dental practitioners, and their consent was subsequently obtained. A cross-sectional questionnaire design was employed and a structured, pre-tested, self-administered questionnaire comprising of a total of 48 items was employed in the present study. Information pertaining to demographic data such as age, gender, educational qualification, and type and duration of practice was also collected.

The knowledge of dental practitioners towards radiation hazards and protection was assessed using 16 items. The knowledge domain of the questionnaire focused on the effects of ionizing radiation on living tissues and the various patient-, operator-, and equipment-related protection

measures that provide safety against these radiation induced hazards. The possible score for the knowledge domain was in the range of 0-16, with each item being scored 0 or 1 based on the accuracy of the answer.

The attitude domain of the questionnaire was composed of a total of 14 items. These items explored dental practitioners' attitude towards prescription of radiographs; usage of lead barriers for the patient, operator, and radiographic room; usage of high speed films and film holding devices; and position of the operator while exposing radiographs. A five-point Likert scale was employed for the attitude domain, with each item having options of 'strongly agree', 'agree', 'unsure', 'disagree', and 'strongly disagree'. For each item, the answer with the most favorable attitude was scored 5 whereas that with the least was scored as 1. Hence, the possible score for the attitude domain was 14-70.

The radiation protection practices of the study subjects were assessed using 15 items, which mainly concentrated on the usage of lead barriers and high speed films; the type and collimation of the X-ray machine; modification of exposure parameters based on the tooth of interest; position of the operator; intra-oral stabilization of the film; and exposure of other patients and attendants to radiation. The possible score for the practice domain of the questionnaire was 0-15. Each item of the practice domain was scored as 0 or 1 based on observance of the radiation protection measures among the dental practitioners.

The questionnaire also enquired about prior training of the study subjects in radiation protection; their perception towards the need to spread awareness about radiation hazards and protection; and their willingness to gain and implement knowledge on radiation hazards and protection into their practice.

Data analysis was conducted by employing SPSS (version 16.0, SPSS Inc., Chicago, IL, USA). The Cronbach's alpha and split-half reliability values were obtained for each of the domains of the questionnaire. The Student's t test was employed to assess differences in various domains among demographic variables. Pearson's correlation analysis was performed to assess the correlation among demographic variables and domains, and also among various domains.

## Results

The results of the pilot study indicated that the Cronbach's alpha and split-half reliability values for various domains of the questionnaire were acceptable. The Cronbach's alpha and split-half reliability values for knowledge,

**Table 1.** Comparison of knowledge, attitude, and behavior scores among study subjects

Demographic variables		No.	Knowledge	Attitude	Practices
Age (years)	≤40	68	9.49 (2.42)	59.79 (6.67)	5.50 (3.04)
	≥41	19	9.74 (3.00)	57.95 (8.15)	6.90 (3.54)
Sex	Male	45	9.69 (2.53)	59.07 (7.10)	6.18 (3.35)
	Female	42	9.38 (2.57)	59.74 (6.97)	5.40 (3.00)
Education	BDS	33	9.09 (3.00)	56.70 (6.48)***	5.88 (2.81)
	MDS	54	9.81 (2.20)	61.04 (6.86)***	5.76 (3.43)
Type of practice	Clinic	35	8.66 (2.78)**	57.23 (7.17)*	5.69 (2.87)
	Clinic+College	52	10.13 (2.21)**	60.85 (6.57)*	5.88 (3.41)
Duration of practice (years)	≤10	62	9.79 (2.56)	60.08 (6.66)	5.37 (3.15)*
	≥11	25	8.92 (2.43)	57.68 (7.69)	6.88 (3.10)*
Total		87	9.54 (2.54)	59.39 (7.01)	5.80 (3.19)
Percentage		100.0%	59.6%	84.8%	38.7%

\*: significant at <0.05, \*\*: significant at <0.01, \*\*\*: significant at <0.001. BDS: Bachelor of Dental Surgery, MDS: Master of Dental Surgery

**Table 2.** Comparison of various parameters among study subjects

Demographic variables		No.	Previous training		Spread awareness		Willingness to know	
			Yes	No	Yes	No	Yes	No
Age (years)	≤40	68	12	56	68	0	65	3
	≥41	19	10	9	18	1	17	2
Sex	Male	45	16	29	44	1	41	4
	Female	42	6	36	42	0	41	1
Education	BDS	33	6	27	33	0	32	1
	MDS	54	16	38	53	1	50	4
Type of practice	Clinic	35	8	27	35	0	33	2
	Clinic+College	52	14	38	51	1	49	3
Duration of practice (years)	≤10	62	14	48	62	0	59	3
	≥11	25	8	17	24	1	23	2
Total number		87	22	65	86	1	82	5
Percentage		100.0%	25.3%	74.7%	98.9%	1.2%	94.3%	5.8%

BDS: Bachelor of Dental Surgery, MDS: Master of Dental Surgery

attitudes, and practices were found to be 0.65 and 0.66; 0.88 and 0.83; and 0.78 and 0.69, respectively. A total of 87 out of 120 respondents participated in the final study, with a response rate of 72.5%.

A majority of the respondents, 68 (78.2%), were aged ≤40 years, while 19 (21.8%) were aged ≥41 years. Of the respondents, 45 were male, while 42 were female. Overall, 33 (37.9%) respondents were university graduates (Bachelor's of Dental Surgery; BDS), whereas 54 (62.1%) of the remaining subjects had completed post-graduate work (Master's of Dental Surgery; MDS) in various specialties of dentistry. A total of 52 (59.8%) subjects were associated with an academic institution along with their private practice, while the remaining 35 (40.2%) had only a private practice. A majority of respondents (62; 71.3%) had ≤10 years of experience in practice while 25 (28.7%) had ≥11 years of experience.

The mean knowledge, attitude, and practice scores of

the respondents were  $9.54 \pm 2.54$  (59.6%),  $59.39 \pm 7.01$  (84.8%), and  $5.80 \pm 3.19$  (38.7%), respectively. Results of the present study indicate that the subjects who were attached to an academic institution along with private practice had better knowledge ( $p=0.01$ ) and attitude ( $p=0.02$ ) scores than those who were in private practice only. It was also observed that the respondents who had completed an MDS had better attitude scores ( $p=0.00$ ) than BDS graduates. At the same time, respondents with ≥11 years of experience in practice had better radiation protection practices than those with less experience ( $p=0.04$ ) (Table 1).

As seen in Table 2, only 25.3% of the subjects had undergone previous training in radiation protection. A total of 98.9% of the respondents felt the need to spread awareness and 94.3% were willing to improve their knowledge on radiation hazards and protection and implement the same into their practice.

The results of the correlation analysis revealed that there

**Table 3.** Correlation analysis of demographic variables with various parameters among study subjects

	Knowledge		Attitude		Practices		Previous training		Spread awareness		Willingness to know	
	r value	p-value	r value	p-value	r value	p-value	r value	p-value	r value	p-value	r value	p-value
Age	-0.09	0.40	-0.10	0.32	0.12	0.28	0.27	0.01**	-0.13	0.25	-0.09	0.39
Sex	-0.08	0.46	0.06	0.61	-0.13	0.25	5.20	0.03*	0.94	1.00	1.70	0.36
Education	0.12	0.27	0.34	0.00***	-0.03	0.77	1.42	0.31	0.62	1.00	0.72	0.65
Type of practice	0.27	0.01**	0.27	0.01**	0.02	0.83	0.18	0.80	0.68	1.00	0.00	1.00
Duration of practice	-0.08	0.48	-0.12	0.29	0.18	0.09	0.24	0.03*	-0.12	0.28	-0.07	0.53

\*: significant at <0.05, \*\*: significant at <0.01, \*\*\*: significant at <0.001

**Table 4.** Correlation analysis between various parameters among study subjects

	Knowledge		Attitude		Practices		Previous training		Spread awareness		Willingness to know	
	r value	p-value	r value	p-value	r value	p-value	r value	p-value	r value	p-value	r value	p-value
Knowledge	-	-										
Attitude	0.30	0.01**	-	-								
Practices	0.24	0.03*	0.09	0.41	-	-						
Previous training	0.20	0.06	0.09	0.41	0.44	0.00***	-	-				
Spread awareness	-0.03	0.80	0.19	0.09	-0.02	0.89	0.34	1.00	-	-		
Willingness to know	0.18	0.09	0.03	0.76	0.02	0.85	0.08	1.00	16.59	0.06	-	-

\*: significant at <0.05, \*\*: significant at <0.01, \*\*\*: significant at <0.001

was a significant association of knowledge with type of practice (r=0.27, p=0.01); and attitudes with type of practice (r=0.27, p=0.01) and education (r=0.34, p=0.00). The previous training of the study subjects was significantly correlated with age (r=0.27, p=0.01), sex (r=5.20, p=0.03), and duration of practice (r=0.24, p=0.03) (Table 3). Knowledge was significantly associated with the attitudes (r=0.30, p=0.01) and practices (r=0.24, p=0.03) of the study subjects. It was also observed that practices were significantly correlated with the previous training (r=0.44, p=0.00) of the respondents (Table 4).

### Discussion

Although the radiation exposure encountered in dentistry is minimal, its harmful effects cannot be ruled out.<sup>1-4</sup> The present guideline to be followed in order to combat the ill effects of ionizing radiation is minimal exposure, with the prerequisite that the benefits of exposure outweigh the risks entailed.<sup>6-8</sup> On the other hand, the literature has reported the noncompliance of dental practitioners with these radiation protection guidelines worldwide.<sup>5,9-15</sup>

There is a definite need to identify the pitfalls hindering the effective implementation of radiation protection guidelines among dental professionals. In this regard, it is essential to investigate all the issues related to radiation protec-

tion simultaneously in a single population to explore various interactions among these parameters. This will pave the way for the implementation of effective radiation protection practices for the benefit of both patients and dental practitioners. There is a definite scarcity of literature exploring the associations of various parameters of radiation protection with each other and with socio-demographic factors, especially in the Indian context.

Hence, the present study was conducted to explore various issues related to radiation protection in Indian dental practice comprehensively. The present study was the first investigation to simultaneously explore various issues related to radiation protection among Indian dental practitioners. It assessed Indian dental practitioners' knowledge, attitudes, practices, previous training, perceived need to spread awareness, and willingness to gain and implement knowledge about radiation hazards and protection. The study also aimed at evaluating the interactions of the aforementioned variables with respect to each other and the influence of socio-demographic factors.

To effectively control and prevent radiation-induced hazards, it is essential to understand the effects of ionizing radiation on the health of an individual. These questions represent the knowledge domain of radiation protection, and studies which address the same have been reported in the literature. Various researchers<sup>5,12-14,16,20,21</sup> have reported

a lack of knowledge of dental practitioners towards radiation hazards and protection. The mean knowledge score in the present study was 9.54 ( $\pm 2.54$ ) on a scale of 0 to 16, which is consistent with the aforementioned reports. In a similar study conducted by Razi et al,<sup>14</sup> the mean of the correct answers was 6.47 ( $\pm 1.66$ ) on a scale of 15 items.

The respondents in the present study scored 59.39 ( $\pm 7.01$ ) on a scale of 14 to 70 in the attitude domain, which represents the extent of the positive attitude of the study subjects. A similar study conducted by Svenson et al<sup>17</sup> reported the affective attitude of their study subjects towards radiation protection. Positive attitudes indicate a possibility to improve on radiation protection and further studies are required to elaborate on various issues related to the attitude of dental practitioners toward radiation protection.

Although the study subjects had positive attitudes, their mean practice score was 5.80 ( $\pm 3.19$ ) on a scale of 0 to 15, indicating a lack of adherence to radiation protection guidelines. Various researchers<sup>5,9,11-13,18-20,22-25</sup> have reported similar findings. Low scores in the practice domain of the present study may be attributed to the respondents' lack of knowledge of radiation hazards and protection measures. However, the knowledge-attitude-behavior (KAB) model of the KAB continuum may not be entirely effective in explaining the low practice scores of study subjects. There may be other factors that influence the behavior of study subjects regarding radiation protection, which need to be probed by further investigations.

Participants in the present study who were attached to an institution along with private practice had better knowledge and attitude scores than those who were only in private practice, which is in agreement with the results of Svenson et al.<sup>16,18</sup> Further, the attitude scores of the respondents who had completed an MDS were significantly better than those of the BDS graduates. These findings can be attributed to greater exposure to the relevant scientific literature and academic activities like continuing dental education and continuing professional development programs among MDS graduates as compared to their BDS counterparts. Similar advantages could also be attributed to those who are attached to educational institutions as opposed to those who were solely involved in private dental practice.

Respondents with  $\geq 11$  years of experience in practice had better radiation protection practices in the present study. With increasing age, individuals might tend to assume a more responsible stance on issues pertaining to health, and the same might be reflected among the present study subjects. Further studies are required to shed more light

on this association.

It can also be noted that only 25.3% of the present study subjects had undergone previous training in radiation protection. This could be attributed to the lack of a requirement for compulsory training in radiation protection in India prior to using ionizing radiation in dental practice. Lack of previous training could also be one of the important factors contributing to the poor practices of the study subjects. The vast majority (98.9%) of respondents felt the need to spread awareness and 94.3% were willing to gain and implement knowledge about radiation hazards and protection measures. This finding further reinforces the need to train dental practitioners in radiation protection prior to using ionizing radiation in their practice.

It was observed that there was significant correlation of knowledge with the attitudes and practices of the study subjects, confirming the results of Svenson et al.<sup>16</sup> Earlier studies<sup>5,12,13</sup> concluded that poor practices are due to lack of knowledge, and in order to minimize radiation, attempts should be made at educating and improving dentists' knowledge. It was also noted in the present study that the practices of the respondents were significantly correlated with previous training, confirming the results of Svenson et al.<sup>18</sup> This finding highlights the role of training in enhancing the awareness and knowledge of dental practitioners, and in motivating them to incorporate low dose techniques in their practice.

The results of the present study also revealed that there was a significant association of knowledge with the type of practice. This again can be attributed to the higher exposure of respondents working in educational institutions to scientific literature and continuing dental education programs. However, the knowledge of the study subjects was not associated with their age, sex, educational status, or duration of practice. In contrast, Svenson et al<sup>16,19</sup> reported an association of knowledge with educational status, and duration and type of practice. Ezoddini Ardakani and Sarayesh<sup>10</sup> concluded that specialist dentists were more knowledgeable than general dentists. Razi et al<sup>14</sup> reported an inverse correlation of knowledge with the age of their study subjects, but found no association between knowledge and duration of practice.

The attitudes of respondents in the present study were significantly correlated with educational status and type of practice, which is in accordance with Svenson et al,<sup>18</sup> who reported an association of attitudes with type of practice. Low-dose practices in the present study were independent of age, sex, educational status, and type and duration of practice. In contrast, a similar study<sup>18</sup> reported that type

of practice and a short one-day course were found to be predictors of low-dose practices. The previous training of the present study's respondents was significantly correlated with age, sex, and duration of practice. Further studies are essential to explore the role of socio-demographic variables on various aspects of radiation protection.

The present study needs to be viewed in the light of the following limitations. The investigation included dental practitioners of Mangalore city and the results of the present study have to be confirmed among a larger sample. Studies that involve the use of questionnaires are susceptible to acquiescence (yea-saying) bias, deviation (faking bad) bias, and social desirability (faking good) bias.

There is a definite need to reinforce the importance of radiation protection in the dental curriculum in India. The training of dental practitioners must be mandated prior to the use of ionizing radiation in dental practice in India. Recertification at regular intervals must be enforced in order to monitor implementation of low-dose techniques in practice. In order to persuade dental practitioners to use low-dose practices, there is a need to expand knowledge and awareness by means of training and continuing dental education programs on radiation hazards and protection. The present study highlights the need for policy changes to bring the aforementioned proposals to fruition.

In conclusion, the knowledge and practices of the study subjects pertaining to radiation hazards and protection were poor, whereas they had high attitude scores towards the same. Most of the study subjects had not received any previous training in radiation protection. However, the majority of them felt the need to spread awareness and was willing to gain and implement knowledge about radiation hazards and protection.

Demographic variables showed a significant association with various parameters pertaining to radiation protection in the present population. The present study highlights the need for training and recertification programs for effective radiation protection practices among Indian dental practitioners and has policy implications for the same.

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