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RADIATION SAFETY AND CHALLENGES AMONG DENTAL PROFESSIONALS

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Abstract

Radiation safety practices plays a pivotal role among the professionals who work with ionizing radiation equipment. Safety practices like lead aprons have the advantage of protecting from radiation hazards but are reported to cause other occupational hazards. So a safety practice without compromising the regular activities is essential. The aim and objective of the study are to assess the radiation safety practice and hassles faced by dental professionals through a questionnaire study. Then to assess whether such radiation safety practices by the dental professionals suffer from any related occupational hazards which is affecting their regular activities. A questionnaire study was conducted among two hundred and ten dental professionals. The questionnaire consisted of 15 questions which were structured to assess the radiation safety practice, difficulties faced, and hazards suffered to implement such practice. The responses were recorded and statistically analyzed. The results depicted that most of the professionals follow radiation safety practices in the work area. Most of the dentist suffered from pain using aprons affecting their day-to-day activities. The study depicts that dental professionals require awareness regarding the handling and storage of their protective equipment like lead aprons. To protect the apron from occult damage resulting in chronic radiation injury. The further thickness of the apron should be considered before use which in turn impacts weight and affects the musculoskeletal component.

INTRODUCTION

The X-rays play a significant role in the diagnosis and treatment plan of many pathologies. Even though other nonionizing modalities are available in medical practice to choose an alternative to X-rays, the dental practice diagnosis still solely depends on ionizing radiation practice. Most of the colleges and clinics in India have their radiology set up to give satisfying treatment to their patients. However, ionizing radiation use needs a proper safety practice. As the drops of water form an ocean, long-term accumulation of this radiation produces hazardous effects. During the initial use of X-rays, professionals working in the radiation field lack sufficient knowledge of post-exposure hazards. So a safety practice evolved for years to date. The safety practices include the use of a lead apron, lead barrier, lead goggles, thyroid collar, gonadal shield, or position distance rule, etc. There are international and national level regulatory bodies that insist on radiation safety methods in the radiation work area.

As stated “not doing the image” is the best radiation protection.[1] This is practically difficult with all the patients as requirements vary on a case basis. A lead apron is one of the personal protective equipment that provides the highest level of safety against ionizing radiation. The main function of a lead apron is

to provide protection against secondary radiation and provide protection of around 75% to radiosensitive organs.[2] The protective effect of lead apron thickness should be at least 0.25 mm for 100 kV X-ray machines and 0.35 mm
lead for X-ray machines over 100 kV.[2] However, wearing an additional overcoat produces discomfort during the dental procedure. There are studies reported that musculoskeletal pain is more prevalent among lead apron users.[3]
So this study was conducted to assess the safety practices in their radiation work area and the difficulties faced in implementing those practices.

Materials and methods

The study was conducted by an online questionnaire that involved General Dental Practitioners and all specialty dentists. The questionnaire included a set of fifteen questions regarding their regular day-to-day radiation protection practice in the dental setup. The study was conducted among two hundred and ten dentists who work with dental X-ray equipment. The study was conducted after getting approval from the Institution's Ethics Committee. For parametric analysis frequency and percentage were assessed. For non-parametric analysis, Spearman's rho correlation was used. The level of statistical significance was set at $p \leq 0.05$.

Results

Out of two hundred and ten samples assessed 138 (65.7%) participants were between the age group of 20-30 years of age and 133 (63.3%) were female participants [Table 1&2]. Among the designation parameters assessed majority were General Dental Practitioners with 107(51%) participants [Table 3]. Among the most common types of equipment used in their workplace was an intraoral periapical radiograph with 102(48.6%) [Table 4]. The precautions taken by most of the dental professionals that is around 61 (29%) participants against radiation were all the measures for protection and 11 (23%) participants were not with any precautionary methods against radiation [Table 5]. Around 109 (51.9%) participants didn't know the thickness of the lead apron in use [Table 6]. Most of the participants around 171 (81.4%) wear lead aprons for less than one hour [Table 7]. Around 115 (54.8%) and 95 (45.2%), participants used double-sided and single-sided aprons respectively [Table 8]. Out of 210 participants, 152 (72.4%) store the lead apron using a hanger [Table 9]. Out of 210 responses 20 participants (9.5%) had back pain, 3 (1.4%) had joint pain, 70(33.3%) had shoulder pain, 40 (19%) participants had all the categorized pain and 77(36.7) had no pain [Table 10]. Around 145 (69%) responded that pain didn't affect their day-to-day activities and the remaining 65 (31%) participants had affected activities [Table 11]. Among the most common reasons for neglecting the lead apron was the weight of the apron with around 89 (42.4%) participants followed by some unexplained discomfort with 71 (33.8%) participants [Table 12]. Out of 210 participants, 164(78.1%) restrict the number of exposure in a day [Table 13]. Most of the participants around 127 (60.5%) didn't use any other radiation protective accessories in their work area [Table 14]. Nonparametric analysis between pain while wearing an apron and pain affecting their day-to- day activities reveal a significant correlation (p=0.00) [Table 15]. Another correlation between other radiation protection accessories and restricting the number of uses revealed a significant correlation (p=0.02) [Table 16].

Discussion

Dental professionals should be well aware of radiation safety practices in their work area. So that dentists can ensure protection against themselves, their colleagues in the work area, and patients.
The findings of this study suggest most of the participants around 65.7% were in the age group between 20 to 30years. The majority of the participants 63.3% were female dental practitioners. Among all the participants the general dental practitioners were 51% followed by Oral Medicine and Radiologist with

17.6%. The remaining specialty participants were within 10% each.

Among the X-ray equipment used by our participants, the intraoral periapical radiograph is the most commonly used radiographic evaluation with 48.6% followed by both periapical and panoramic with 27.1% then Cone Beam Computed Tomography with 18.1%. Erdelyi RA et al in their study stated that the most commonly used dental radiographic techniques in day-to-day practice are intraoral periapical radiograph panoramic radiography, and also Cone Beam Computed Tomography (CBCT).[4]

The majority of the participants in our study around 29% follow proper radiation safety practices indicating that they know X-ray hazards. However, 11% of the participants didn't follow any radiation protection practice and 11.9% used the position distance rule. The studies conducted by Kharwade NN et al and BS Aravind revealed that most of the dental practitioners follow position distance rule in their study and need an awareness regarding the safety practice.[5] Regarding the thickness of the lead apron used around 51.9% of participants are not aware
of it. A questionnaire study conducted by Sheth B et al reveals that 45% of their responders were unaware of the thickness of the apron.[6]

In our study around 81.4% wear lead aprons less than 1 hour a day and around 54.8% of participants use double-sided aprons. Around 72.4% store the lead apron by placing it in the hanger.

A study conducted by Oyar O and KışlalıoğluA found that radiation personals were not aware of the preservation and storage of lead aprons. The aprons were assessed and found that there were holes and cracks to permeate the radiation of around 12.5 times greater. Oyar O, Kışlalıoğlu A stated that in their institution radiation personnel didn't give proper care for cleaning, and storage of lead aprons.[7]

The Musculoskeletal pain was reported in most of the participants wearing a lead apron around 63.3% and 36.7% of participants didn't feel any pain. Further, this pain affected day-to-day activities in 31% and didn't affect 69% of participants. The use of aprons with prolonged standing or sitting alters the posture to cause discomfort and repeated long-term chronic injury over years leads to pain.[8] But Moore B et al stated that the severity of back pain must be assessed by the participants themselves as it is a subjective symptom. They also stated that not all lead aprons are the same.[9] The study conducted by Livingstone RS et al found that 47% of participants had shoulder pain and back pain with the use of a single-sided apron.[2] the results were similar to our study with 33.3% reporting shoulder pain, 19.9% shoulder and back pain, and 9.5% with back pain. The co- existence of factors such as practice duration, type of work, and other lifestyle habits could produce significant effects to be considered.

Around 31% of the respondents revealed that their regular activities are affected due to the pain. The study conducted by Livingstone RS et al found that half of their respondents had spine issues and one-third missed their work.[2] Most of our respondents around 42.4% felt neglected wearing an apron because of weight followed by 33.8% due to some discomfort. The most common reason for neglecting the apron was the lack of availability and weight of the lead apron.[10] This can be reduced by a less weight apron or double-sided apron[2] which helps equally distribute the stress.There was a significant correlation between discomfort or pain wearing the apron and those affecting day-to-day activities (Table 15).

Around 78.1% of our participants restrict the number of X-rays taken in a day. This could be due to the knowledge of participants about radiation hazards. Furthermore, another reason could be due to 60.5% of participants didn't use any other radiation protection accessories like thyroid collars, lead goggles, and gonadal shields. Further, a significant correlation exists between the use of radiation protection accessories and restricting the number of X-rays used by our participants (Table 16). A study conducted by Yıldız. A, Kose E, Demirtas OC found that the radiation professionals followed the ALARA (as low as

reasonably achievable) principle to protect themselves from radiation by minimizing exposure and by using personal monitoring devices.[11]

Conclusion

In conclusion, the majority of the dental professionals in our study follow better radiation safety practices. However, the knowledge regarding personal safety equipment, handling, and their hazards seems to be insignificant. The respondents in our study have pain and discomfort while using a lead apron affecting their regular activities. The weight of the lead apron psychologically made our participants neglect wearing it affecting their safety practice. So awareness is required for dental practitioners regarding the handling of the radiation protective equipment, and their hazards.

Ethical considerations

The questionnaires were filled by the participants and identity was not included in any of the articles. Personal information of the participants has not been revealed in any of the articles included in this article.

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TABLES

Table 1 Age frequency

Age	Frequency	%
20-30	138	65.7
31-40	40	19.0
41-50	26	12.4
above 50	6	2.9
Total	210	100.0

Table 2 Gender frequency

Gender	Frequency	%
Male	77	36.7
Female	133	63.3
Total	210	100.0

Table 3 Designation frequency

Designation	Frequency	%
Oral Medicine and Radiologist	37	17.6
Oral Maxillofacial surgeon	9	4.3
Periodontist	15	7.1
Pedodontist	15	7.1
Prosthodontist	4	1.9
Endodontist	5	2.4
Orthodontist	11	5.2
Public Health Dentist	4	1.9
Oral Pathologist	3	1.4
General Dental Practitioner	107	51.0
Total	210	100.0

Table 4 Type equipment you work with

Type of equipment	Frequency	%
Intra oral periapical radiograph	102	48.6
Panoramic radiograph	10	4.8
Intra oral periapical radiograph & Panoramic radiograph	57	27.1
Panoramic radiograph & Cone beam computed tomography	3	1.4
Cone beam computed tomography	38	18.1
Total	210	100.0

Table 5 What precaution do you take to protect yourself from radiation protection

Protection methods	Frequency	%
Position distance rule (PD rule)	25	11.9
Wear Lead apron	25	11.9
Stand behind lean barrier	22	10.5
PD rule &lead apron	12	5.7
Lead apron and barrier	16	7.6
PD rule and lead barrier	26	12.4
all of the above	61	29.0
none of the above	23	11.0
Total	210	100.0

Table 6 The thickness of the lead apron in use

Thickness	Frequency	%
0.25	23	11.0
0.35	32	15.2
0.50	46	21.9

Table 7 approximately how many hours do you wear your lead apron

Duration of wear	Frequency	Percent
less than 1 hour	171	81.4
1-3 hours	24	11.4
More than 3 hours	15	7.1
Total	210	100.0

Table 8 Type of lead apron in use

Type	Frequency	Percent
single side	95	45.2
double side	115	54.8
Total	210	100.0

Table 9 Where do you store your lead apron when not in use

Storage of apron	Frequency	Percent
Hanger	152	72.4
over table	29	13.8
fold and keep it safe	29	13.8
Total	210	100.0

Table 10 What pain do you have while wearing lead apron

Pain	Frequency	Percent
back pain	20	9.5
joint pain	3	1.4
shoulder pain	70	33.3
all above	40	19.0
none above	77	36.7
Total	210	100.0

Table 11 Does the pain caused due to lead apron use affect your day to day activities

Day to day activities	Frequency	Percent
yes	65	31.0
no	145	69.0
Total	210	100.0

Table 12 Did you ever felt to neglect wearing lead apron if yes most common reason was

Reason to neglect apron	Frequency	Percent
Weight of apron	89	42.4
discomfort	71	33.8
dehydration	9	4.3
wear apron	41	19.5
Total	210	100.0

Table 13 Do you restrict the number of patient x-ray exposure in a day

Restrict X-ray exposure	Frequency	Percent
yes, I take limited x-ray	164	78.1
no, I take for all the patients	46	21.9
Total	210	100.0

Table 14 What other radiation protection accessories do you wear while taking x-rays

Accessories	Frequency	Percent
thyroid collar	47	22.4
gonad shield	1	0.5
gloves lead	8	3.8
all	27	12.9
none	127	60.5
Total	210	100.0

Table 15 Nonparametric Correlations between discomfort and pain while wearing apron and affecting the day to day activities

			pain caused due to lead apron use affect your day to day activities
Spearman's rho	discomfort or pain while wearing lead apron	Correlation Coefficient	.281**
		Sig. (2-tailed)	.000
		N	210

Table 16 Nonparametric Correlations for other accessories and restricting number of x-rays, neglect to wear apron and type of lead apron

			Do u restrict the number of x-rays
Spearman's rho	other accessories	Correlation Coefficient	.213**
		Sig. (2-tailed)	.002
		N	210