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"KNOWLEDGE AND PRACTICE REGARDING SAFETY STANDARDS OF ORAL RADIOLOGY AMONG DENTAL PRACTITIONERS IN DENTAL COLLEGE, BIHAR"

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Abstract

In Dentistry, radiographic evaluation is required but professional negligence or ignorance can lead to radiation hazards so the knowledge regarding safety standards among Dentists is necessary. The aim of the study was to investigate the knowledge and behavior of Dental practitioner regarding safety during oral radiographic procedures. It was a survey based study enrolled 100 dentists. A 13 semi - structured, validated questionnaire was used to assess knowledge and practice related to safety standards in Oral Radiology. The study revealed that amongst 100 Practitioners; 48 had > 5 years experiences, 86 had one machine, 61 had less than 5 years old machine. 97 used RVG, 73 took less than 10 radiographs per day, 65 didn't hold the X-Ray film with their fingers, 59 didn't use lead apron and 49 stood near patient without wearing lead apron, 54 did periodic check-up only when needed, 50 had to repeat, 54 didn't know safe distance, 75 didn't know the exposure time and 52 took radiographs of pregnant women. The study conclude that the periodic training and regular monitoring should be mandatory to improve knowledge about radiation and dose reduction techniques.

INTRODUCTION

In dentistry, radiographic evaluation is required in the majority of the cases before, during, and even after treatment. Hence, both dental practitioners and patients are at an increased risk of exposure to radiation if appropriate protective measures aren't taken.[1] Knowledge of dental health professionals about radiation safety - related guidelines is crucial. The International Commission on Radiological Protection (ICRP), the National Council on Radiation Protection and Measurements (NCRP), and the Atomic Energy Regulatory Board (AERB) provide guidelines about permissible doses, equipment, and working protocols for occupational and nonoccupational personnel. The rules and regulations about radiation safety norms are to be followed by all the dental operatories in India.[2] The 'As Low As Reasonably Achievable (ALARA) principle should be followed to minimize these effects.[1] Radiographer's deals with ionising radiation daily, and as a consequence,

the doses they receive are much higher than the ones of the general public. Thus, they have a higher risk in developing an ionising radiation - induced complication. General public is not aware of the consequences of ionising radiation exposure, therefore medical personnel who are directly involved need to take appropriate measures for radiation protection to protect themselves, the general public and the environment. The effects of ionising radiation exposure fall into two categories, stochastic and deterministic. The chance of producing a stochastic effect raises when the radiation dose increases. Stochastic effects do not have a dose threshold and characterise a possible outcome in any dose such as cancer: the adverse effects could appear after 10-20 years. In deterministic effects, the severity of the outcome increases when the radiation dose is higher. Thus, deterministic effects have a dose threshold, and with the threshold exceeded. Several harmful outcomes are possible depending on the radiation dose received.[3] Thus, besides the extensive benefits obtained from the diagnostic application of X-rays in both medicine and dentistry, professional negligence or ignorance can lead to radiation hazards which are harmful to the living tissues in a way that is enough to cause cancer.[4] Unnecessary radiation exposure to the patients and operators can be prevented by using good equipment, proper technique, and optimal processing methods. The methods of radiation protection are usually taught during undergraduate training, and dentists are expected to follow them in private practice.[1]

In physicians, partial body radiation such as the hands should not exceed 500 mSv per year. Radiation to the thyroid gland and eyes should even stay below 300 and 150 mSv per year. For example, a surgeon is exposed to a radiation dose of 0.05 mSv per minute at

a distance of approximately 0.5 m.[5] In some countries, dentists are required to undergo certificate courses in radiation protection apart from their undergraduate training, and a permit is required for the use of radiographic equipment in the dental office. In India, however, no separate training is required. Therefore, the aim and objective of present study was to investigate the knowledge and practice regarding safety standards of oral radiology among dental practitioners during oral radiographic procedures in dental college, Bihar.[1]

MATERIAL AND METHOD

The present ethics committee - approved study (Institutional Ethics Committee, IEC-BIDSH, Ref. No :- 121/BIDSH/IEC/2024-25(2023-24) was conducted among Dental Practitioners in Buddha Institute of Dental College and Hospital, Bihar. Under inclusion criteria , Dental Practitioner getting exposed while there was a radiography procedure, working in the Buddha Institute of Dental College and Hospital, Bihar. One hundred practitioners were selected by simple random sampling using random number tables. The study protocol was explained to the participants, and the consent was obtained. A 13 item questionnaire in English was used to assess the participant's knowledge about the need for radiation protection and safety measures and adherence to radiation safety protocol in the dental radiology. The questionnaires were distributed to these 100 dental practitioners . The participation was voluntary, and confidentiality was assured. A few questions were objective in nature with "yes" or "no" options, whereas most of the questions had multiple choices. Questions to assess knowledge and practice were related to periodic check-ups of X-ray equipment, repetition of radiographs, the method of holding the film, use of a lead apron, the position and distance rule, adjustment of the exposure time, and performing

radiographs of pregnant women.[1] The data was obtained.

responses were analyzed, and quantitative

Knowledge and Practice regarding safety standards of Oral Radiology among Dental practitioners in Dental College, Bihar

NAME OF THE PRACTITIONER-

DEPARTMENT-

1. How many years have you been involved in private practice ?
   A) 1 - 5 years B) 6 - 10 years C) 11 – 12 years D) > 15 years

2. How many intraoral X-ray machines are there in your clinic ?
   A) 0 B) 1 C) 2 D) > 2

3. How old is your X-ray machine ?
   A) 1 - 5 years B) 6 - 10 years C) > 10 years

4. Do you have periodic check – ups performed for your X-ray equipment ?

   A) Yes B) no C) only when needed

5. Which type of radiographic receptor do you use ?

   A) Conventional film B) digital sensor (RVG)

6. How many IOPA radiographs do you take in your dental clinic daily ?

   A) < 10 B) 10 - 20 C) 20 - 30 D) > 30

7. How many times do you need to repeat the radiograph before you obtain a good image ?

   A) Do not have to repeat B) once C) twice D) more than twice

8. Do you or your assistant hold the X-ray film with your fingers while taking periapical Radiographs ?

   A) yes B) no

9. Do you use a lead apron for patient protection ?

   A) yes, always B) yes, occasionally C) no

10. Where do you stand during intraoral exposure ?

A) behind a protective wall C) behind a lead screen

B) near patient without lead apron D) near the patient wearing a lead apron

11. If there is no barrier between you and the patient, in which area do you stand according to the X-ray tube and what is your distance from the patient ?
    A) 135^{O} to tube and 6 feet away C) 160^{O} to tube and 8 feet away
    B) 110^{O} to tube and 3 feet away D) Do not know

12. How do you adjust the exposure time under the following conditions?

from overweight patient to thin patient

A) increase B) decrease C) no change

from anterior teeth to posterior teeth

A) increase B) decrease C) no change

From adult patient to pediatric patient

A) increase B) decrease C) no change

13. Do you take periapical radiographs of a pregnant women

A) yes B) no

RESPONSES OF STUDY POPULATION TO QUESTIONNAIRE

QUESTIONS	RESPONSE	NUMBER	%
1. How many years have you been involved in private Practice?	1-5 years	48	48.0
	6-10 years	32	32.0
	11-12 years	7	7.0
	>15 years	13	13
2. How many intraoral x-ray machines are there in your Clinic?	0	0	0
	1	86	86
	2	14	14
	>2	0	0
3. How old is your x-ray machine?	1-5 years	61	61
	6-10 years	35	35
	>10 years	4	4
4. Do you have periodic check-ups performed for your x-ray equipment?	Yes	12	12
	No	34	34

	Only when needed	54	54
5. Which types of radiographic receptor do you use?	Conventional film	3	3
	Digital sensor (RVG)	97	97
6. How many IOPA radiographs do you take in your	<10	73	73
Dental clinic daily?	10-20	23	23
	20-30	4	4
	>30	0	0
7. How many times do you need to repeat the radiograph	Do not have to repeat	50	50
Before you obtain a good image?	Once	45	45
	Twice	4	4
	More than twice	1	1
8. Do you or your assistant hold the x-ray film with your	yes	33	33
Fingers while taking periapical radiographs?	No	65	65
9. Do you use a lead apron for patient protection?	Yes, always	11	11
	Yes, occasionally	30	30
	No	59	59
10. Where do you stand during intraoral exposure?	Behind a protective wall	17	17
	Behind a lead screen	18	18
	Near patient without wearing lead apron	49	49
	Near the patient with wearing lead apron	16	16
11. If there is no barrier between you and the patient	135° to tube and 6 feet away	33	33
	110° to tube and 3 feet away	9	9
	160° to tube and 8 feet away	4	4
	Do not know	54	54
12. (A) How do you adjust the exposure time under the	Increase	6	6
Following conditions? From overweight patient	Decrease	19	19
To thin patient	No change	75	75
(B) How do you adjust the exposure time under the	Increase	23	23
Following conditions? From anterior teeth to	Decrease	11	11
Posterior teeth	No change	66	66
(C) How do you adjust the exposure time under the	Increase	4	4
Following conditions? From adult patient to	Decrease	34	34
Paediatric patients	No change	62	62
13. Do you take periapical radiographs of a pregnant	Yes	52	52
Women	No	48	48

RESULTS

Results were analysed statistically using the t-test for binary exposure variables and one - way analysis of variance (ANOVA) for exposure variables with > 2 categories. The knowledge score was normally distributed ; Mean scores and mean differences were estimated with participant characteristics as the independent categorical variables and the knowledge scale as a numeric dependent variable, using ANOVA and the t-test, wherever applicable. For analyses involving > 2 categories based on an overall p-value for group differences were estimated by default using ANOVA, which provided p - values for each group comparison (as compared to the first / reference group). Statistical significance was assumed as p - value < 0.05 (5 % Significance Level).

Demographic profile of the study subjects

Most practitioners were early in their private practice careers, with 48 % had 1–5 years of experience and 32 % with 6 –10 years. Only 7 % had practiced for 11–12 years, while 13 % have over 15 years of experience. Overall, 80 % had 10 or fewer years in private practice, indicating a predominantly early to mid career group.

Question	Response	Number	Percentage
1. How many years have you been involved in private practice ?	A) 1 - 5 Years	48	48.0
	B) 6 - 10 Years	32	32.0
	C) 11 - 12 Years	7	7.0
	D) > 15 Years	13	13.0

Radiographic equipment

The majority of clinics (86 %) had one intraoral X-ray machine, while 14 % have two. None of the respondents reported had zero or more than two machines,

indicating that most clinics are equipped with at least one, but not more than two, intraoral X-ray units.

Question	Response	Number	Percentage
2. How many intraoral X-ray machines are there in your clinic ?	A) 0	00	00
	B) 1	86	86
	C) 2	14	14
	D) >2	00	00

While, 61 % of respondents had X-ray machines that was 1–5 years old, 35 % reported machines aged 6 –10 years, and only 4% had machines older than 10 years. This suggests that most clinics were equipped with relatively new X-ray equipment.

Question	Response	Number	Percentage
3. How old is your X-ray machine ?	A) 1 – 5 Years	61	61
	B) 6 – 10 Years	35	35
	C) > 10 Years	4	4

And only 12 % of respondents conduct periodic check - ups of their X-ray equipment, while 34 % did not perform regular maintenance. Notably, the majority 54 % only carried out check - ups when needed, indicating a reactive rather than preventive approach to equipment maintenance.

Question	Response	Number	Percentage
4. Do you have periodic check - ups performed for your X-ray equipment ?	A) Yes	12	12
	B) No	34	34
	C) Only when needed	54	54

Image receptors

A vast majority of respondents (97 %) used digital sensors (RVG) as their preferred radiographic receptor, while only a small fraction (3%) used conventional film. This indicates a strong shift towards digital radiography in clinical practice.

Question	Response	Number	Percentage
5. Which type of radiographic receptor do you use ?	A) Conventional film	3	3
	B) Digital sensor (RVG)	97	97

Response of participants

most dental practitioners (73%) took fewer than 10 IOPA radiographs daily. A smaller proportion (23%) took between 10–20 radiographs, and only 4% took 20–30 radiograph daily. Notably, none of the respondents reported taking more than 30 radiographs per day. This suggests that most clinics operate at a moderate diagnostic imaging workload.

Question	Response	Number	Percentage
6. How many IOPA radiographs do you take in your dental clinic daily?	A) <10	73	73
	B)10-20	23	23
	C) 20-30	4	4
	D) >30	00	00

50 % of respondents had no need to repeat radiographs to obtain a good image, indicating efficient technique and equipment use. Meanwhile, 45 % required a single repeat, and only a small fraction 4 % and 1 % need two or more repetitions respectively. This suggests overall satisfactory radiographic accuracy and minimal retakes in most clinical settings.

Question	Response	Number	Percentage
7. How many times do you need to repeat the radiograph before you obtain a good image ?	A) Do not have to repeat	50	50
	B) Once	45	45
	C) Twice	4	4
	D) More than twice	1	1

65 % of respondents did not hold the X-ray film with their fingers while taking periapical radiographs, adhering to radiation safety protocols. However, 33 % still report holding the film manually, indicating a need for improved awareness and training on safe radiographic practices.

Question	Response	Number	Percentage
8. Do you or your assistant hold the X-ray film with your fingers while taking periapical Radiographs ?	A) YES	33	33
	B) NO	67	67

Methods of patient protection

Practitioner showed inconsistent use of lead aprons, with 11 % always used them, 30 % occasionally, and 59 % not used them at all, highlighting gaps in radiation safety practices.

Question	Response	Number	Percentage
9. Do you use a lead apron for patient protection?	A) Yes, always	11	11
	B) Yes, occasionally	30	30
	C) No	59	59

Methods of personal protection

Most individuals (**49%**) stood near the patient without a lead apron, risking radiation exposure. Only **18 %** positioned themselves behind a lead screen, while **17 %** stood behind a protective wall for safety. A smaller **16 %** wore a lead apron near the patient, providing limited protection. These findings highlight inadequate shielding measures in intraoral exposure settings.

Question	Response	Number	Percentage
10. Where do you stand during intraoral exposure ?	A) Behind a protective wall	17	17
	B) Behind a lead screen	18	18
	C) Near patient without wearing lead apron	49	49
	D) Near the patient while wearing a lead apron	16	16

Only 33 % of individuals correctly selected option of standing 135^0 to the tube and 6 feet away. However, the most striking observation was that 54 % of individuals indicated that they did not know the correct response. This suggests a widespread gap in knowledge regarding radiation safety measures, emphasizing the urgent need for improved training and awareness to ensure proper protective positioning during X-ray procedures.

Question	Response	Number	Percentage
11. If there is no barrier between you and the patient, in which area do you stand according to the X-ray tube and what is your distance from the patient ?	A) 135^0 to tube and 6 feet away	33	33
	B) 110^0 to tube and 3 feet away	9	9
	C) 160^0 to tube and 8 feet away	4	4
	D) Do not know	54	54

Participants knowledge of radiation protection

75% of respondents recommend no change in exposure time when imaging thin

versus overweight patients, while 19 % suggest decreasing it and only 6 % advocate increasing it. This indicates a strong preference for consistent exposure settings, possibly due to automated systems or standardized protocols, with minor adjustments for thinner patients.

Question	Response	Number	Percentage
12 (A). How do you adjust the exposure time under the following conditions, From overweight patient to thin patient ?	A) Increase	6	6
	B) Decrease	19	19
	C) No change	75	75

While 66% of respondents recommend no change in exposure time when transitioning from imaging anterior teeth to posterior teeth. A smaller proportion (23%) suggest increasing exposure time, while only 11 % advise decreasing it. This indicates a general preference for maintaining consistent exposure settings, likely due to standardized imaging protocols or compensating techniques. The minority advocating for increased exposure may account for the greater density of posterior teeth and surrounding structures.

Question	Response	Number	Percentage
12(B) How do you adjust the exposure time under the following conditions , from anterior teeth to posterior teeth ?	A) Increase	23	23
	B) Decrease	11	11
	C) No change	66	66

62 % of respondents keep exposure time unchanged when imaging pediatric versus adult patients, while 34 % decrease it likely due to smaller patient size and lower radiation needs. Only 4 % increase exposure, suggesting it is rarely required for pediatric cases. Most favour standardized or adjusted protocols over higher exposure.

Question	Response	Number	Percentage
12 (C) How do you adjust the exposure time under the following conditions , from adult patient to pediatric patient ?	A) Increase	4	4
	B) Decrease	34	34
	C) No change	62	62

52 % of practitioners taking periapical radiographs for pregnant patients (likely using precautions like shielding) and 48 % avoiding it, reflecting caution over fetal radiation exposure. This split underscore varying clinical judgments about necessity and safety in prenatal dental care.

Question	Response	Number	Percentage
13. Do you take periapical radiographs of a pregnant women	A) YES	52	52
	B) NO	48	48

DISCUSSION

To be certain of the radiation safety of the patient and the operator, protocols, principles and guidelines had given to achieve radiation exposure dose for the patient As Low As Reasonably Possible. Routine check up of X-Ray machine is one of the basic steps of quality assurance to ensure optimal radiation exposure without any radiation leakage. In our study 12 % of the practitioner ensured regular maintenance check-ups of their X-ray machines ; which was lower than those obtained in studies by Sheikh et al. One of the main advantages of the Digital sensor is reduce exposure of X-ray upto 80 % as compare to conventional methods. In the present study 97 % of the practitioner were using digital imaging which was more than that reported by Jacobs et al. To avoid repetition high degree of sharpness and resolution is required. This can be obtained by using Proper equipment, Proper radiographic technique, Correct processing and Interpretation of the image. A Lead apron is a protective piece of equipment that attenuates 98 % of scattered radiation. In this study 11 % practioner uses lead apron for patient protection and this percentage was lower than that reported by Math et al. The preferred method for operator protection during radiographic exposure was to position the receptor with a holding device and to leave room or to use a protective barrior or to stand at least 6 feet from the patient at an angle of 90-135 degree to the central X-Ray beam. In our study only 4 % of practitioner were aware of the position and distance rule, which can be used when no protective barrior is present and this percentage was lower than Lee et al. Selecting an appropriate exposure time is very important to minimize the patient's radiation exposure and obtain an image with proper density and contrast. Pediatric patients require 25-50 % less exposure than do adults. Underweight

patients require less exposure than do overweight patients. Edentulous patient require 25 % less exposure than do dentulous patients. In this study 68 % of dentists didn't changed the exposure time according to patient's age, build and the region of the oral cavity being radiographed. Even radiographs can be taken during pregnancy if the patient wear lead apron to avoid greatest risk to the foetus for abnormality. In our study 48 % of practitioner thought that radiographs cannot be taken in pregnant women. Although the Knowledge of Dentists about Radiation Protection Techniques in our study was fair and acceptable but they should implement proper radiation protection techniques and guidelines concerning patient and personnel safety.

CONCLUSION

The implementation of recommended radiation safety protocols and practices in the dentistry is vital for the safety of the working personnel, patients, and environment. By following the radiation safety guidelines, dental professionals can protect themselves and others from the hazards of radiation. The present study revealed the importance of awareness and adherence to radiation safety measures among dental practitioners and the need for more studies to be conducted in this domain. This study demonstrated that most of the participants revealed a reasonable knowledge of the need for personnel protection, safety measures, and adherence to radiation safety protocol. The periodic training and regular monitoring of occupationally exposed dental practitioners should be mandatory to ensure appropriate compliance with radiation safety

regulations.

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