

Assessment of Awareness on Radiation Protection among Dental Practitioners: A Cross Sectional Study.

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Abstract

Objective: To perform a questionnaire based survey of private dental clinics among dental practitioners of central Uttar Pradesh (Lucknow) and gain insight in the knowledge and attitude of Lucknow dentists towards quality care in radiology and radiation protection.

Methods: This survey was performed on 100 dental practitioners from Lucknow which is capital of Uttar Pradesh, India. A questionnaire consisting of 30 questions was given to these people to evaluate their knowledge of ionizing radiation and their awareness of the radiation doses that result from radiological examinations.

Results: The study yielded a response rate of 100% out of which 79% have intra oral radiographic machine and 56% have periodic checkup for their X-ray equipment. The respondents' knowledge concerning the technical details of their equipment was limited, with 53% not knowing kVp settings of their equipment. Only 12% and 28% respondents reported having long and rectangular collimators respectively. Regarding the film speed 54% dental practitioners were unaware about it. The most

preferred technique (90%) for periapical radiography was the bisecting angle technique (60%). None of the dental practitioners had thyroid collars. 26% of the dentists assisted in holding the image receptor inside the patient's mouth. Only 24% of the dental practitioners reported that they used automatic processor. None of the dental practitioners used film badges.

Conclusion: It was alarming to know that dentists' knowledge and awareness regarding radiation protection techniques in dental clinics was not satisfactory. Therefore, attempts should be made to improve dentists' knowledge about radiation dose reduction techniques by giving more emphasis on radiation hazards and protection techniques in undergraduate and postgraduate curriculum.

Keywords: X-ray radiation, radiation safety, dental practitioners, radiation hazards, digital radiography.

Introduction

The radiographic examination is one of the principal diagnostic methods used in all fields of dental and medical services hence a certain amount of radiation is inevitably delivered to patients. It is well known that X-Ray

radiations are harmful still there is a general disregard for basic but, important radiation safety practices in the new “digital age” of Radiology. Radiation has negative biological effects on living organisms, depending on the dose and the duration of exposure [1, 2]. The doses of x-rays used for dental diagnostic purposes are small, but cumulative effects can be hazardous and stochastic effects are not dose dependent. Considering the growing number of people exposed to x-ray radiation makes low-level x-ray radiation dosing a more pressing concern[3]. This situation has produced the concept of keeping radiation exposure "as low as reasonably achievable"— The ALARA Principle, which recognizes the possibility that no matter how small the dose is, some stochastic effect may result. Hence the role of appropriate knowledge of radiation its hazards and radiation protection becomes very important.

Materials And Methods

The study population was dentists practicing in Lucknow, India. The investigators visited 150 private dental practitioners in Lucknow, India, but only 100 dentists who showed interest to participate in the study and had radiographic equipment in their clinic were chosen as the study sample. A written informed consent was taken from all the participants. A 30-point questionnaire was given to the participants [Appendix 1]. Demographic data such as age, gender, educational qualification, and type and duration of practice were also collected. Mean was calculated for demographic variables. For all variables, frequency and percentage were calculated. The significance of difference between two independent groups was determined using Chi-squared test. Level of significance was set at 0.05.

Results

The study yielded a response rate of 100%.

Profile of respondents

Among the 100 respondents, 65 were male and 35 were female dentists. 50% of the respondents were below 35 years and 50% were above 35 years of age. Of the 100 respondents, 60% identified themselves as non-specialist and 40% as specialist. (Table 1a)

Maintenance of the radiographic equipment

Only 56% dentists reported that their X-ray units had been serviced routinely. 39% of them had machine of more than 5yrs.

Characteristics of the radiographic equipment (Table 1b).

The respondents’ knowledge concerning the technical details of their equipment was limited, with 72% not knowing the tube current, 53% tube voltage and 57% the amount of filtration of their machine. It was worrying that 14% of the dental practitioners did use their equipment set at <65 kVp.

Collimation

Only 28% of the dental practitioners used the rectangular collimator, whereas only 12% used the long cone.

Radiographic film

Nearly 55% of the practitioners preferred the conventional radiographs in which, most of them used higher speed classes (E speed: 64% or F speed: 0%), with only 1% of the respondents still using the slow D-speed film and 35% did not know the speed of the film they used. Only 22% dentists replied that they had digital radiography.

Radiographic techniques

90% of the dental practitioners prefer to take intra oral periapical radiographs for diagnosis of dental caries (80.5%) and bisecting angle technique was the most preferred technique among the dentists.

Film holder

55% of the dental practitioner exposed more than 45 intraoral radiographs every month. The majority of the dental practitioners (49%) reported using film holders. But

25% of the dental practitioners asked their patients to hold the films inside the mouth with their fingers for almost every exposure. Unfortunately, 26% of the dentists held the film themselves while the radiograph was being taken of the patient.

Distance

The aforementioned 26% of the dental practitioners, holding the film into the patient's mouth, always stood next to the patient during the radiographic exposures. 79% of the dental practitioners did not had lead barrier in their clinic, 36% standing at a distance of 6 feet and 46% of dental practitioners stand at the angle of 90-135 degree while exposure of x-ray film.

Processing

24% of the dental practitioners reported that they used automatic processor, 42% manual processing and 34% had digital sensors in their clinic. 54% dental practitioners had separate processing room in their clinic.

Radiation protection for patient and personnel :(Table 2)

Almost 55% of the dental practitioners did not wear the lead aprons. 71% of the practitioners took radiographs without any patient protection. 51% of the dental practitioners were aware about the thyroid gland being the most sensitive organ to dental radiography but 82% never use thyroid shield for the thyroid protection in their clinic. 68% had no idea about thickness of lead in lead apron used. 100% of the dental practitioners never used dosimeter to measure radiation exposure.

Discussion

The goal of intraoral and extraoral imaging is to produce high-quality images of the oral structures with a minimum of radiation exposure [4]. The means of protection is broadly divided into [5]:

- A. Protection for the operator.
- B. Protection for the patient.

C. Protection for the environment.

Protection for the Operator

The Operator should protect themselves from two most important sources of X-rays to which they are exposed i.e. the primary X-ray beam and scattered radiation originating from the irradiated tissues of the patient.

Protection for the Patient

Begins with Patient selection where radiographic examination should be done only when it will provide information affecting their treatment and prognosis.

- i. Selection of the Image Receptor: Use of high speed films (E), which will help reduce the exposure time. Use of screen films, the use of intensifying screens also helps reduce exposure time to the patient.
- ii. Focal Spot Film Distance (FSFD): Longer FSFD results in 32% reduction in exposed tissue volume.
- iii. Collimation of the Beam: Collimation decreases the risk of radiation, minimizes scattered radiation and decreases the fog, with a sharper image and better contrast.
- iv. Filtration: Filtration preferentially absorbs low energy photons.
- v. Film holding devices: they provide an external guide to indicate the film position, the possibility of misaligning the X-ray tube.
- vi. Use of protective barriers: When used the lead apron should have a protective equivalent of 1/4th mm of lead.
- vii. Use of proper technique: The use of proper technique for the imaging of the particular anatomy of the patient.
- viii. Processing the image: If films are not processed properly, retakes are required, increasing patient exposure and cost.

Protection for the Environment

The surrounding environment must be protected from radiation to avoid exposure to persons in the environment.

- i. Primary beam should be directed only towards the patient.
- ii. Patient should be positioned such that the X-ray beam is aimed at the wall of the room and not through a door or other opening.
- iii. Walls made of 3" of concrete, 3" × 16" of steel or 1 mm of lead will suffice to protect adjacent room.

Continuing education

Practitioners should stay informed of new information on radiation safety issues as well as developments in equipment, materials and techniques and adopt appropriate items to improve radiographic practice. Radiation monitoring is measuring of the X-ray exposure of operators or associated personnel as a protective measure. Regular radiation surveys, should be performed at regular intervals as the amount of exposure is dependent on many factors, such as:

- A. the machine's kilo voltage.
- B. the work load of the X-ray machine
- C. the X-ray absorbing ability of the walls (by using radiation measuring device).
- D. the amount of time the adjacent areas are occupied by people.

Within oral radiology, studies have shown that dentists have incomplete knowledge of radiological guidelines.[6-8] One of the basic steps of quality assurance is X-ray machine maintenance, and regular checkups of the equipment are a necessity. In our study, 56% of the dental practitioners performed regular check-ups of their X-ray machines and the results of study conducted by the Jacobs et al [9] are consistent with the present study. In our study, the dentists' knowledge about the details of radiographic equipment which they used was insufficient. 53% did not know the kilovoltage peak (kVp), 72% unaware of tube current and 57% did not know about filtration of their machine and the results are in consistent with the study

conducted by D Ilguy et al[10]. 54% of dentists could not even comprehend "speed" of the film. 60% dentists preferred technique was bisecting angle technique for periapical radiography. Our findings show that the use of the most sensitive film should be accompanied by suitable processing since the use of manual processing techniques together with inadequate time control of the process leads to a much smaller reduction in the radiation dose administered than is possible. In our study, manual processing techniques was used by 42% of the participants. Automatic processing was used by 24% and the incorporation of digital technology (34%) would help reduce the radiation dose used since the errors which commonly occur at present with manual processing would disappear as consistent with the results of M Alcaraz et al. [11]

For periapical radiography, restriction of the beam cross section to conform to the size of the image receptor (rectangular collimation) is recommended. But unfortunately in our study rectangular collimator was used only by 28% of the dental practitioners. The results were concurrent with the Eskandarlou et al.[12]

Two standard focal source to- skin distances used for intraoral radiography are 20 cm (8 inch) and 40 cm (16 inch). In our study, 88% dentists preferred 8 inch collimator whereas 12% preferred the 16 inch collimator. This is concurrent with the results of Bohay RN.[13] According to Gibbs et al., the use of 16-inch PID results in 10-25% overall dose reduction, 38-45% dose reduction to thyroid gland and 13% dose reduction to salivary glands, than 8-inch PID.[14]

Standing at a distance of an average 6 feet and at an angle of 90-135 degree from the patient while taking radiographs, seems to be a safe distance but in our study 26% of the dentists hold the film inside the patient's mouth staying next to the patient. 79% did not had lead

barriers in their clinic. 55% never used lead apron and 82% never used thyroid collar. 100% did not have any dose monitoring and 44% did not know of radiographic machine periodic calibration. Similar results were obtained in study conducted by Sumona Pal et al.¹⁵ The negative response in this survey on dosimetry is far higher than that reported by Math et al. only 40%. [16]

In conclusion, the results indicate that for minimizing any unnecessary radiation, attempts should be made to improve dentists' knowledge about radiation dose reduction techniques. After graduation dentists must update their knowledge by attending meetings and reading dental journals. Continuing educational programs can help to improve the radiation safety for dental patients as well for the operators.

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Legends Tables

Table 1: tabulation of all the findings at each follow up

Table 1 General information of participants:

Age distribution		Sex distribution		Qualification Details	
< 35 years	> 35 years	Male	Female	Specialist	Non Specialist
50	50	65	35	40	60

Table 1 b)

Lack of awareness of technical details of equipment			Collimator		Films Used			Radiographic techniques			
Tube current	Tube voltage	Amount of filtration	Rectangular	Long-cone	E speed	D speed	Didn't know	Bisecting angle	Paralleling	Intra-Oral Periapical radiograph	Panaromic radiograph
72	53	57	28	12	64	1	35	80.5	19.5	90	10

Table 1 c)

Use of film holder			Distance			Processing		
Used Film Holder	Asked patients to hold the Film	Held the film themselves	Stand next to the Patient	Stand 6ft from the Patient	Stand at an angle of 90-135	Automatic Processor	Manual Processor	Digital Sensor
49%	25%	26%	26%	36%	46%	24%	42%	34%

Table 2

General findings of the survey on Radiation protection for patient and personal:	
55%	Did not wear the lead aprons.
71%	Did not use lead apron for patient protection.
25%	Took radiographs for pregnant woman without any protection.
51%	Were aware about the thyroid gland being the most sensitive organ to dental radiography.
82%	Never use thyroid shield for the thyroid protection in their clinic.
68%	Had no idea about thickness of lead in lead apron used.
100%	Never used dosimeter to measure radiation exposure.

Appendix 1

Survey Questionnaire

Registration no.

Age & gender.

Years of dental practice:

. <5ys .5-10ys .11-25ys .>25ys

You work as:

. General practitioner . Specialist

1. What dental radiographic machine do you have?

.Intraoral .Extra oral .Both .None

2. What is the age of your x-ray machine?

.1yr .>1yr . <5yr .>5yr

3. Do you have periodic check-up for your x-ray equipment?

. Yes .No

4. How many radiographs do you take monthly in your clinic:

.>10 .>20 .>45 >60

5. Which type of collimator do you use?

. Cylindrical . Rectangular .pointed .don't know

6. What is the length of your collimator?

.20cm .30cm .40cm .pointed cone

7. Average number of bitewing radiographs/occlusal radiographs advised per week:.....

8. Number of extra oral radiographs (OPG, PNS, Lat Ceph etc) advised per week.....

9. Kilovoltage of IOPAR machine.

. <60kvp .60-80kvp .>80kvp . No idea

10. Tube current of IOPAR machine:

.8m A .10m A .12m A . No idea

11. What is the average exposure time for IOPAR?

. <0.5Sec .0.5-0.8sec .0.9-1.2 sec > 1.2sec

12. What type of radiographic receptor do you use?

.conventional film .Digital receptors

13. Which film speed do you use?

. D speed . E speed . F speed . Don't know

14. What technique do you use for periapical radiography?

. Paralleling technique . Bisecting angle technique

15. What is the amount of filtration present in your radiographic equipment?

. 1mmAl . 1.5mmAl . 2mmAl . Don't know

16. At what distance from the radiation tube are you positioned during exposure.
. 5feet .6feet .8feet .10feet
17. At what angle from the x-ray tube operator should stand during exposure in case of no barrier protection.
. <90degree .90-135degree .>135degree . Any
18. Do you wear lead aprons during radiographic exposures?
. Yes . No
19. Do you use lead aprons on your patients during radiographic exposures?
. Yes . No
20. Thickness of lead apron used.
. 0.25mm .0.5mm .0.75mm .No idea
21. Do your patients wear a thyroid collar while being exposed to x-ray?
. Always . Sometimes . Never
22. Do you use dosimeter to measure the radiation dose?
.yes . No
23. Which is the most sensitive organ in dental radiography?
. Gonads . Bone marrow . Thyroid .Salivary glands
24. When taking an intraoral radiograph on a patient.
. Patients hold the films inside the mouth by their fingers
.Operator holds film in patient's mouth.
. You use a film holder.
25. Do you have lead barrier in your clinic?
. Yes . No
26. Do you take radiographs for pregnant women?
.Yes . No
27. Which trimester is safest?
. 1st . 2nd .3rd . Any .None
28. In pregnant females what precautions you take.
. Lead aprons . Thyroid collar . Both . None
29. Do you have separate processing room?
. Yes . No
30. How do you process your exposed radiographs?
. Automatic . Manual . Self-developed films . Digital sensors