



Radiation protection in dentistry - Do we practice what we learn?

Sumona Pal¹, Preeti Tomar Bhattacharya², Rupam Sinha²

¹Clove Dental, New Delhi, India, ²Department of Oral Medicine and Radiology, Haldia Institute of Dental Sciences and Research, Haldia, West Bengal, India

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Correspondence:

Dr. Sumona Pal, Clove Dental, New Delhi, India. Phone: +91-9560328910, E-mail: sumona_capri@yahoo.co.in

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Abstract

Aim: Easy availability, overuse, and lack of reinforcement of the radiation hazards facts have unknowingly resulted in overlooking of as low as reasonably achievable (ALARA) among many dentists. The current survey was designed to assess the awareness, concern, and practice of radiation protection in general dental practice.

Materials and Methods: The survey involved 156 dentists in West Bengal, India. A cross-sectional self-administered questionnaire consisting of a total of 28 items was employed. The obtained data were compiled systemically and significance of difference was calculated by Chi-squared test using Statistical Package for Social Sciences 17.

Results: Bisecting angle technique and use of E-speed films with manual processing were the most common. The majority of the participants had no idea about the type of cone used (37.2%), tube current (37.8%), kVp 56.4% (88). Exposure time was equally variable with maximum variability in the case of digital radiographs. Use of lead barriers and aprons were poor.

Conclusion: The knowledge and practice of radiation protection are not satisfactory. Repeated reinforcement and training and the most importantly change in attitude to follow ALARA is required.

Introduction

X-ray is invisible but its effects are not. Radiological investigations are the first modality of diagnosis in most oral and maxillofacial disorders nevertheless its detrimental effects cannot be ignored. Easy availability, overuse without proper knowledge, and lack of reinforcement of the radiation hazards facts have unknowingly resulted in overlooking of as low as reasonably achievable (ALARA) principles in many cases.^[1,2]

The survey was designed to assess the awareness, concern and practice of radiation protection in general dental practice in the state of West Bengal in India.

Materials and Methods

The study population was dentists practicing in West Bengal, India. The Institutional Review Board, Haldia College of Dental Sciences, Haldia gave ethical approval for the study. The investigators visited 250 private dental practitioners in west Bengal, India, but only 156 dentists who had diagnostic dental radiographic examination facility in their clinics were chosen

as the study sample. A written informed consent was taken from all the participants. A 28-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.

Data were compiled systemically and were analyzed by using Statistical Package for Social Sciences Chicago III software version 17. 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

Questionnaires were distributed to 250 dentists, but only 156 (62.4%) were considered as study subject as they possessed radiographic unit. Of 156 dentists, 134 were male and 22 female dentists. 75.6% (118) were university graduates (BDS) and 24.4% (38) were post-graduates (MDS) involved in general practice. 34.6% (54) had <5 years of experience, 28.8% (45)

5-10 years' experience, 23.7% (37) had 11-25 years of experience, and 12.8% (20) had >25 years of experience [Graph 1].

About 61.5% (96) had either intraoral X-ray unit or extraoral unit or both. Majority of the dentists 85.3% advised for radiographs only after clinical examinations. Intraoral periapical radiograph (IOPAR) was a common radiograph advised (44.2% advised at least 30-49 IOPAR/week) followed by orthopantomogram (OPG) (39.7% advised for at least 1 OPG/week). Bitewing/occlusal were not very commonly advised.

Majority of the participants had no idea about the type of cone used (37.2% i.e., 58), tube current 37.8% (59). 56.4% (88) dentists said that kVp of dental X-ray machine should be within 60-80 kVp and 50% used cylindrical collimation. Though about half of them kept the exposure time 0.5-0.8 s about 20% used a longer exposure 1.2 s. 62.2% (97) of the respondents used films, mostly E-speed films. Among 8.9% (14) who used digital sensors, 50% had no idea about the type used. In case of extraoral radiography, 60.3% had no idea of the type of receptor being used. 49.4% (77) preferred bisecting angle technique, only a mere 3.2% used film holders, 55% (86) used patients finger, 7.8% assistant used to hold film, and remaining 34% of the dentist used to hold the film themselves. 87.3% used manual processing or both, only 3.8% automatic processing rest used digital imaging. 35.9% changed processing solutions every week. A shocking fact was noticed that 83.3% of those using manual processing through the processing solutions in sewage drains and lead foils in dustbins.

Around 40.3% (63) of the responders did not stand behind any barriers during exposure. Many of the dentists were completely unaware of the position distance rule to be followed in case of lack of barrier. Only 59% of the responders knew correctly where to stand during exposure (>6 feet), 10.9% had no idea while 30.1% answered it wrongly. Similarly, 45.7% did not know the correct angulations to stand. 46.2% (72) of the dentists never made their patients wear lead apron 60.9% (95) did not use thyroid collar, 42.3% (66) of the dentists never wore the lead apron during exposure. More than half 51.3% (80) did not have any idea of the correct thickness of lead apron. 93.6% (146) did not have any form of dose monitoring and 45.5% (71) did not know of radiographic machine periodic calibration. Awareness of radiation protection and pregnancy was good. 51.3% (80) said X-ray should only be done in emergency, 57% (89) considered second trimester to be safest for radiographs, but 16.7% (26) considered it can be done in any trimester.

Discussion

Most of the dentists were not familiar with the technical specifications of their equipment. 82.3% had no idea regarding the kilovoltage peak of their machine. For radiation safety of the patients, a radiographic source between 60 kVp and 70 kVp be used.^[3] 10.8% of dentists could not even comprehend "speed" of the film. 94.1% dentists preferred technique was bisecting angle technique for periapical radiography, similar to study by Sheikh *et al.*^[4]

Higher qualifications (MDS) showed a significant difference only in the type of radiographic machine ($P = 0.026$), number of radiographs taken ($P = 0.049$), and preferred periapical technique ($P = 0.037$). This was in contrast to the findings by other studies,^[5] where MDS had a better attitude score probably due to better exposure to relevant scientific literature and continuing dental education programs. This indicates that the prevailing attitude toward radiation protection is very casual in West Bengal dentists.

Use of rectangular collimator reduces the dose about 5 times in comparison to the circular cone.^[6] In our study, only 27% of the dentists used rectangular collimator, the results were slightly higher than other studies Math *et al.* (7%),^[6] Belgium (6%),^[7] Turkey 5.5%.^[3]

About 50% of the study population thought 0.5-0.8 s as the ideal exposure time. However, with increased use of handheld portable X-ray devices with lesser kVp (most uses 60 kVp), the duration of exposure used is often longer.^[8] In good agreement with another study,^[6] 62.2% of the dentists used E-speed films. Interestingly, survey showed 5.1% used self-processing films. Since self-processing films are not commonly available in West Bengal does it reflect social desirability bias?

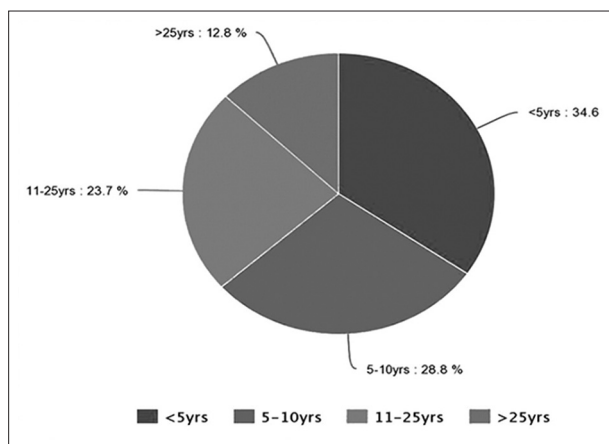
Only 8.9% (14) used digital radiography which is less than the results of Ilgüy *et al.*,^[3] Kaviani *et al.*^[9] Dentist should be encouraged to use faster films and digital radiography as it requires only half the exposure of E-speed films.^[6] Only a mere 3.2% used film holders, in others patient, dentist or assistant used to hold the film. Use of bisecting angle technique is more common than paralleling in consistent with results of other studies.^[3,6,7] Another interesting finding was that those using digital sensors rarely used a film holder. This is completely paradoxical practice. Use of paralleling cone technique along with film holder reduces unnecessary exposures -ALARA^[6] is followed.

About 87.3% used manual processing or both, only 3.8% automatic processing rest used digital imaging. Results are in good agreement with Math *et al.*^[6] (92%), Ilgüy *et al.*^[3] (85%). About 83.3% of those using manual processing through the processing solutions in sewage drains and lead foils in dustbins indicating that the set guidelines of biomedical waste management are equally not followed.

Portable X-ray units are increasingly used in dentistry. There are no set of guidelines for duration of exposure, position - distance rule is not followed, radiation safety of operator is in question as the unit is handheld, and set angulations for exposures intraoral periapical radiographs cannot be met especially for lowers as the X-ray unit is obstructed by the patient's upper thorax and shoulders. The authors are in agreement Berkhouet *et al.*^[10] for an international set guidelines for handheld digital X-ray.

Quite the reverse to the study of Binnal *et al.*,^[5] we found younger dentists had better radiation protection practice probably attributed to training in undergraduate course.

Most dentists do not take radiographs irrespective of the necessity if the patient is pregnant due to the fear of exposure of radiation to the fetus. Nevertheless, a study finding by Kusama and Ota^[11] showed no direct radiation to the fetus in head and chest diagnostic exposures and that the absorbed dose was <0.01 mGy.



Graph 1: Distribution of dentist with years of experience

Threshold radiation dose for pregnancy termination is only above 25 rads.^[12] Dose above 0.2 Gy may lead to the development of congenital defects, growth retardation, and abortion.^[12]

The first trimester of pregnancy is the most susceptible period to radiation-induced damages.^[13] Radiographic procedure can be carried out in pregnancy only in utter necessity exercising entire precautions to lessen the radiation dose.^[14] Awareness regarding pregnancy and radiation exposure was (51.3%). Only 16.7% (27) considered diagnostic radiation can be done in any of the trimester (with all precautions), 57% considered second trimester to be safest.

Given that the practice of holding the film by fingers and use of portable dental unit were high around 40.3% (63) of the dentist did not stand behind any barriers during exposure rather stood beside the patient. Many of the dentists were completely unaware of the position distance rule to be followed in case of lack of barrier. Only 59% of the responders knew correct distance to stand during exposure (>6 feet), similarly only 55.8% knew the correct angulation to stand to avoid being in the direction of primary and secondary radiation.

About 93.6% did not have any dose monitoring and 45.5% did not know of radiographic machine periodic calibration. The negative response in this survey on dosimetry is far higher than that reported by Math *et al.* only 40%.^[6] A large group of dentists never used lead apron and thyroid collars. This is irrespective of years of experience or qualification and gender which is unlike other studies.^[6,7] This brings forward the gaping difference in clinical practice and theoretical knowledge imbibed in undergraduate courses. Perhaps the fact that there was no recognition of dentomaxillofacial radiology as a specialty in West Bengal until 2009 shows the poor level of response. The result of the study should alert the dental professional societies that more attention to be given to the negligent attitude toward dental radiology practice. There are few limitations of this study. The study sample was localized to a particular region where there was no undergraduate radiation protection training. Questionnaires based studies like this are

vulnerable to few biases such as acquiescence (Yeh-saying) bias, deviation (faking bad) bias, and social desirability (faking good) bias.^[5]

Conclusion

At the age of cone beam computed tomography, we are still striving to follow minimal radiation protection measures. Government and dental authority should make it mandatory for all dentists to attend at regular intervals continuing dental education programs on basic imaging in dentistry and radiation protection. Set guidelines for handheld X-ray machine is must. Repeated reinforcement and training and the most significant factor - attitude in each dental professional to follow ALARA will certainly make a great difference in radiation protection for individual and the mass.

References

1. Kantor ML. Longitudinal trends in the use of individualized radiographic examinations at dental schools in the United States and Canada. *J Dent Educ* 2006;70:160-8.
2. Lee BD, Ludlow JB. Attitude of the Korean dentists towards radiation safety and selection criteria. *Imaging Sci Dent* 2013;43:179-84.
3. Ilgüyü D, Ilgüyü M, Dinçer S, Bayirli G. Survey of dental radiological practice in Turkey. *Dentomaxillofac Radiol* 2005;34:222-7.
4. Sheikh S, Pallagatti S, Singla I, Gupta R, Aggarwal A, Singh R, *et al.* Survey of dental radiographical practice in states of Punjab and Haryana in India. *J Investig Clin Dent* 2014;5:72-8.
5. Binnal A, Rajesh G, Denny C, Ahmed J, Nayak V. Insights into the state of radiation protection among a subpopulation of Indian dental practitioners. *Imaging Sci Dent* 2013;43:253-9.
6. Math SY, Murugesappa DG, Annigeri R, Kalra D. Compliance of Indian dentists with oral radiology safety measures. *J Oral Maxillofac Radiol* 2013;1:104-10.
7. Jacobs R, Vanderstappen M, Bogaerts R, Gijbels F. Attitude of the Belgian dentist population towards radiation protection. *Dentomaxillofac Radiol* 2004;33:334-9.
8. Mahdian M, Pakchoian AJ, Dagdeviren D, Alzahrani A, Jalali E, Tadinada A, *et al.* Using hand-held dental X-ray devices: Ensuring safety for patients and operators. *J Am Dent Assoc* 2014;145:1130-2.
9. Kaviani F, Esmaeili F, Balayi E, Pourfattollah N. Evaluation of X-ray protection methods used in dental offices in Tabriz in 2005-2006. *J Dent Res Dent Clin Dent Prospects* 2007;1:49-52.
10. Berkhout WE, Suomalainen A, Brüllmann D, Jacobs R, Horner K, Stamatakis HC. Justification and good practice in using handheld portable dental X-ray equipment: A position paper prepared by the European academy of dentomaxillofacial radiology (EADMFR). *Dentomaxillofac Radiol* 2015;44:20140343.
11. Kusama T, Ota K. Radiological protection for diagnostic examination of pregnant women. *Congenit Anom (Kyoto)* 2002;42:10-4.
12. McCollough CH, Schueler BA, Atwell TD, Braun NN, Regner DM, Brown DL, *et al.* Radiation exposure and pregnancy: When should we be concerned? *Radiographics* 2007;27:909-17.

13. Stewart C, Bushong SC. Radiologic Science for Technologists. 8th ed. St. Louis: Mosby; 2004. p. 531-56.
14. White SC, Pharoah MJ. Oral Radiology: Principles and Interpretation. 6th ed. St. Louis: Mosby; 2009. p. 30-44.

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Appendix-1 : Survey Questionnaire

- Name: _____ Registration NO: _____ Age & Sex _____
- Years of experience in dental practice <5yrs 5-10yrs 11-25yrs >25yrs
- Qualification: _____ Specialization: _____
- Do you work as general practitioner specialist

If you possess any of the dental radiographic machines please reply according to it, if not please reply as per your knowledge and perception.

1. When do you advise radiographs to patients
 based on history after examination routinely
2. What dental radiographic machine do you have
 Intraoral Extraoral Both None, refer to diagnostic center
3. Average number of intraoral radiographs taken/week
 <10 10-29 30-49 50-99 ≥100
4. Number of bitewing radiographs/occlusal radiographs advised / week _____
5. Number of extraoral radiographs (OPG, PNS,LAT CEPH etc) advised/ Week _____
6. Intraoral radiographic machine used is Short cone Long cone NO idea
7. Kilovoltage of intraoral radiographic machine?
 < 60 60-80 KVP >80 KVP NO idea
8. Tube current of the intraoral radiographic machine?
 8mA 10 mA 12 mA NO idea
9. Shape of the collimator (tube head) of intraoral radiographic machine
 Cylindrical Pointed Rectangular NO idea
10. What is the average exposure time for IOPAR?
 < 0.5 sec 0.5- 0.8 sec 0.9- 1.2 sec > 1.2sec
11. How is the radiographic film/sensor usually placed in patient's mouth during exposure?
 Patient's finger Dentist's finger Assistant's finger Film holder
if so: Always often sometimes never
12. Which type of intraoral radiographic receptor do you use?
 Radiographic film, if so
Speed of film used D-speed E-speed F-speed NO idea
 Digital sensors, which one? PSP CCD CMOS No idea
 NO idea
13. Which type of extraoral radiographic receptor do you use?
 Radiographic film with intensifying screen
 Radiographic film without intensifying screen
 Digital sensors, which one? PSP CCD CMOS No idea
 NO idea
14. Which technique do you use for taking IOPAR Paralleling Bisecting angle
 Both NO idea
15. At what distance from the x-ray tube, operator should stand during exposure in case of no barrier protection? <4 ft 4-6ft >6 ft Any
16. At what angle from the x-ray tube, operator should stand during exposure in case of no barrier protection? <90° 90°-135° >135° Any
17. Do you stand behind a protective wall during exposure? NO YES
if YES, of which material is this wall consist? Lead Concrete wood nothing specific required
18. Which type of film processing do you utilize?
 Automatic Manual self processing
19. How frequently do you change your processing solutions?
 Every day 1 week 2 weeks 3weeks 4 weeks NO idea
20. Do all your patients wear a lead apron while being exposed to X-ray?
 Always Sometimes Never
21. Thickness of lead apron 0.25mm 0.5mm 0.75mm NO idea
22. Do your patients wear a thyroid collar while being exposed to X-ray?
 Always Sometimes Never
23. Can you advice dental radiographs in pregnancy YES NO Only in emergencies
24. Which trimester is safest 1st 2nd 3rd Any None, radiographs cannot be taken anytime
25. Do you/ technician/assistant wear a lead apron while exposing films to X-rays?
 Always Sometimes Never
26. Do you use dosimeter to measure the radiation dose? If so, indicate the type.
YES (_____) NO
27. When is your X-ray equipment calibrated? periodically In case of necessity only Never
28. Method followed for disposal of radiation waste.
 Processing solutions into sewage drains, and lead foils in dustbin.
 Electrolytic separation of processing solutions and recycling of lead foils.

Signature with date