BIOSCIENCES BIOTECHNOLOGY RESEARCH ASIA, April 2014. Vol. **11**(1), 263-266

Radiation Protection in Dental Radiology- The Safe Use of Radiographs in Dental Practice

V. Aarthi Nisha[1], J. Parthiban[2], T. Sarumathi[3], V.T. Hemalatha[4] and A. Amudhan[5]

[1,3-5]Sree Balaji Dental College And Hospital, Bharath University, Chennai, India.
[2]Reader, Tagore Dental College and Hospital, Chennai, India.

dx.doi.org/10.13005/bbra/1265

(Received: 10 January 2014; accepted: 05 February 2014)

Radiographs have been widely used in dentistry for various reasons such as diagnosis, treatment planning, during the treatment procedures and assessment of treatment outcome. In our routine dental practice dentists practice intraoral radiography in their clinics. The radiograph when made immediately in the dental chair is a real-time diagnostic aid but the dentist should also confirm whether he/she follows all the guidelines and safety precautions of radiation safety while exposing the patient to X-rays so that the deleterious effects of X-rays can be avoided which will be beneficial to both the patient and especially the dentists who have long term exposure to X-rays. Hence in this article we have emphasized on the safety precautions to be followed by the dentists and also the awareness each of us should possess towards the hazards of radiation.

Key words: Dental radiography, X-rays, Radiation hazards, Safety precautions in dental clinic.

X-rays are a type of electromagnetic (EM) which has short wavelength and high frequency. The importance of this is that high frequency means high energy. When X-rays hit atoms this energy can be transferred, producing ionization of atoms[1]. X rays examinations are an important tool that helps dentists to diagnose, plan treatments and monitor both treatments and lesion development. There are four types of dental radiological procedure: i) intraoral (bitewing, periapical and occlusal) radiography; ii) panoramic radiography; iii) cephalometric radiography and iv) cone-beam CT (CBCT)[2]. Radiographs are essential to dentists for diagnosis, treatment planning and monitoring treatment or lesion development. However, an integral part of radiography is exposure of patients and, potentially, clinical staff to X-rays. No exposure to X-rays can be considered completely free of risk, so the use of radiation by dentists is accompanied by a responsibility to ensure appropriate protection[3].

Choosing the appropriate radiographic examination should also be based upon consideration of the prevalence of diseases, their rates of progression and the diagnostic accuracy of the imaging techniques in question. Radiographic Referral Criteria have been defined as "descriptions of clinical conditions derived from patient signs, symptoms and history that identify patients who are likely to benefit from a particular radiographic technique"[4]. The term 'referral criteria' is appropriate for practitioners, where radiography is usually arranged by referral to a specialist in radiology. However, some dentists may refer patients for radiography to hospitals or dental colleagues where they do not have the necessary equipment in their own practices. When

* To whom all correspondence should be addressed.
Ph: +91-9500027640, +91-9443529399;
E-mail: drnishaparthi@gmail.com

acting as a referrer, the dentist should ensure that adequate clinical information about the patient is provided to the person taking responsibility for the exposure[5].

When patients undergo X-ray examinations, millions of photons pass through their bodies. These can damage any molecule by ionization, but damage to the DNA in the chromosomes is of particular importance. Most DNA damage is repaired immediately, but rarely a portion of a chromosome may be permanently altered (a mutation). While doses and risks for dental radiology are small, a number of epidemiological studies have provided evidence of an increased risk of brain, salivary gland and thyroid tumors for dental radiography[6]. They can be considered as 'chance' (stochastic) effects, where the magnitude of the risk is proportional to the radiation dose. Except in extraordinary circumstances, the deterministic effects are given no further consideration in dental radiography. Individual risks in dental radiography are small but are greater in the younger age groups (below 30 years) in which dental radiography are most frequently performed[7].

This paper will throw light on the safety precautions which has to be followed by every private dental practitioner who also practice dental radiography in their clinic which will provide a protection against harmful effects of radiation to both the dentist and the patient.

Need for radiation protection in dentistry

Diagnostic Reference Levels (DRLs) are patient dose levels for medical diagnostic exposure that can be used as investigation levels as part of this optimisation process. The International Commission on Radiological Protection (ICRP) first introduced the term diagnostic reference level in 1996. The ICRP stated that "the overall objective of radiation protection is to provide an appropriate standard of protection for man without unduly limiting the beneficial practices giving rise to radiation exposure"[8]. The National Commission on Radiation Protection (NCRP) issued a similar statement that "the goal of radiation protection is to prevent the occurrence of serious radiation induced conditions (acute and chronic deterministic effects) in exposed persons and to reduce stochastic effects in exposed persons to a degree that is acceptable in relation to the benefits to the individual and to society from the activities that generate such exposure"[9].

Guidelines for practicing dental radiography

Critical examination of the machine[10]

The plans for the installation of a dental X-ray set should be critically reviewed by a qualified expert to ensure that all aspects of radiation safety for both practice staff and the public. In particular, the following aspects need evaluation:

Installation of the X-ray machine[11]:

On installation, dental X-ray equipment should be subject to the following inspections/ tests:

1. Critical examination of plans for installation from the point of view of radiation safety of staff and members of the public.
2. Acceptance test – performed prior to the equipment's use in clinical practice.
3. Routine tests – these should be performed at regular intervals.

Protection for adjacent areas[12]

It is essential to consider the likely consequences in terms of radiation dose to staff and members of the public in adjacent areas. Protection is often quoted in terms of the thickness of lead (usually some 0.1-1mm) required and this will be dependent on such factors as distance of the barrier from the X-ray tube, the use of adjacent area, workload etc. Alternatively lead lined plywood or plasterboard can be used to obtain the desired protection. For the average dental facility, structural protection can readily be achieved using traditional building material.

Patient and personnel exposure[13]

In routine dental practice, effective dose should never exceed 1 mSv per year, which is the annual dose limit for the public. Likewise, dose to the skin of the hands should be well below the dose limit. However, in the past, incidences of deterministic damage to fingers have been reported in dentists due to the custom of holding the film in the patient's mouth, a practice that should avoided[11]. If patient assistance is required, the assisting adult should be provided with a lead apron and positioned so that all parts of their body are out of the main beam. The dental film or detector should only be held by the patient when it cannot otherwise be kept in position. It should never be hand held by a member of the dental practice staff.

For a point source of radiation, the dose rate falls off as the inverse of the square of the distance from the source (as light intensity falls off at distance from a light bulb). Standing at a distance of 2 m from the patient's head will lead to a dose of roughly a quarter of that received standing only 1 m away. For scattered radiation, the use of distance alone is often adequate protection in the dental situation.

Darkroom and desktop processing units[14]

Routine checks should be made to ensure that darkrooms remain light tight and that safelights do not produce fogging of films. Desktop units should be similarly checked for light-tightness. This can be done using a simple 'coin' test. Routine checks should be carried out every 12 months or if any alterations to darkroom or equipment have been performed.

Room layout[15]

Consideration needs to be given to the layout of the room so that radiation safety is optimized. The room should be of adequate size to allow all staff that needs to remain within the room to position themselves outside the controlled area during exposure. It is essential that the operator of the equipment can position themselves so that they have a view of: patient, controlled area and 'X-rays on' indicator light. If the room size is limited, it might be necessary for staff to position themselves outside the room, in which case a mirror might be required to ensure that a clear view of the room is maintained. The equipment should be positioned so that the controlled area does not extend to any entrances and so that the primary beam will not be directed towards any doorways or ground floor windows. The exposure switch should be located so that that the operator cans either remain outside of the controlled area or be behind a protective screen. In addition, attention should be given to the location of the mains on switch.

Use of protective screens[16]

For low workload situations extra protection for staff is not usually required provided that the room is large enough to allow staff to stand some 2 m away from the patient. However, for high radiographic workload or very cramped location, extra protection can be provided, either in the form of protective panels for staff to stand behind or as protective aprons for staff to wear. If such protection is required it is recommended that the advice of a 'qualified expert' be sought.

Pregnant staff[17]

It is well documented that the fetus is sensitive to ionising radiation. Consequently, special attention is paid to workers using ionising radiation who are pregnant and includes a separate dose limit of 1 mSv to the fetus during the declared term of pregnancy. In dental practice, it would be considered unusual for any members of staff to be exposed to radiation to an extent that would lead to this level of fetal dose. However, female staff should be encouraged to inform their employer of pregnancy. The lead practitioner should ensure that the pregnant employee work load is assessed and if there is a likelihood of the fetal dose exceeding this level then a qualified expert should be consulted for specific advice to ensure that the fetal dose will be limited.

CONCLUSION

Many of us, as dentists, even though have an idea of biological hazards of radiation we do not follow the precautions and safety factors especially in our private practice. We consider that a radiation exposure in a private clinic set up is negligible, which is not true as we ourselves take radiograph for the patients where we get directly exposed to X-rays and definitely in a long term will have deterministic effects affecting us. Hence we should follow strictly the radiation protection rules in our clinical practice so that both patients and we are protected from the hazards of radiation due to the diagnostic radiology.

REFERENCES

1. Velders, X. L., J. van Aken, and P. F. van der Stelt., Risk assessment from bitewing radiography. *Dentomaxillofac Radiol* 1991; **20**: 209-13.
2. International atomic energy agency, Radiological Protection for Medical Exposure to Ionizing Radiation, Safety Guide, RS-G-1.5, IAEA, Vienna 2002.
3. Making the best Use of a Department of Clinical Radiology: Guidelines for Doctors. 4th ed. Royal College of Radiologists, London, 1998.
4. White, S. C., Assessment of radiation risk from dental radiography. *Dentomaxillofac Radiol* 1992; **21**:118- 26.
5. Aideyan, U. O., K. Berbaum, and W. L. Smith.,

Influence of prior radiologic information on the interpretation of radiographic examinations. *Acad Radiol* 1995; **2**:205-8.

6. Maillie, H. D., and J. E. Gilda., Radiation-induced cancer risk in radiographic cephalometry. *Oral Surg Oral Med Oral Pathol* 1993; **75**:631-7.
7. Guidelines on Radiological standards for primary dental care. Volume 5 Number 3. Royal College of Radiologists and National Radiological Protection Board, 1994.
8. ICRP 73 Radiological Protections and Safety in Medicine, 1996; 26.
9. Implementation of the principle of as low as reasonably achievable (ALARA) for medical and dental personnel. Report Number 107. NRCP, 1990.
10. Guidance Notes for Dental Practitioners on the Safe Use of X-Ray Equipment. National Radiological Protection Board, 2001.
11. EU Guidelines on Education and Training in Radiation Protection for Medical Exposures. Radiation Protection 2000; 116.
12. Monsour, P. A., B. J. Kruger, A. Barnes, and A. Sainsbury. Measures taken to reduce X-ray exposure of the patient, operator, and staff. *Australian Dental Journal* 1988; **33**:181-92.
13. Radiation protection in dentistry recommended safety procedures for the use of dental x-ray equipment safety code. Environmental Health Directorate, Canada, 2000.
14. An update on radiographic practices: information and recommendations.ADA Council on Scientific Affairs. *Journal of the American Dental Association* **1988**; 132: 234-8.
15. National Radiological Protection Board., Guidance notes for dental practitioners on the safe use of x-ray equipment. NRPB dental x-ray protection services, 2001.
16. National Radiological Protection Board., Guidance notes for dental practitioners on the safe use of dental radiography and dental x-ray protection services, 2006.
17. Advice on exposure to ionizing radiation during pregnancy. Joint guidance from NRPB, 1998.