



GUIDELINES ON RADIATION SAFETY IN DENTISTRY



**Malaysian
Dental Council**

November 2010

**GUIDELINES
ON
RADIATION SAFETY IN
DENTISTRY**

Second Edition 2010

*Malaysian Dental Council
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Published by:

The Malaysian Dental Council
c/o Oral Health Division
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October 2010

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Citation:

Malaysian Dental Council. Guidelines on Radiation Safety in Dentistry. Second Edition, November 2010



FOREWORD BY THE PRESIDENT OF THE MALAYSIAN DENTAL COUNCIL

The safe and effective use of dental x-ray equipment is important for the protection of the patient, the dental personnel and the public. Up to June 2010, there are a reported 1,889 dental x-ray machines throughout Malaysia, of which 33.1% are sited in public sector dental clinics and the remainder 66.9% are in the private sector. These dental x-ray machines comprise intraoral, panoramic and cephalometric radiographic equipment.

In spite of the low radiation dose of the average dental radiological examination, repeated exposures may pose a potential hazard to individuals. It is well shown that exposures can be minimised through meticulous adherence to good practices. Hence, this second edition document for the dental profession is a review and update on the first document that was initially produced for the Ministry of Health in 2006. The aim of this document is to ensure that dental personnel understand and practice precautionary measures for use of ionizing radiation and that dental practitioners comply with requirements on radiation safety. These include monitoring performance of x-ray equipment and implementing quality assurance (QA) activities.

I take this opportunity to thank all personnel involved in the preparation of this document.

A handwritten signature in black ink, appearing to read 'Ismail Merican'.

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Acknowledgement

The Malaysian Dental Council members record their gratitude and appreciation to the following for their contribution:

- Members of the working group in the Oral Health Division, Ministry of Health Malaysia
- Officers of the Radiation Health and Safety Branch, Engineering Services Division, Ministry of Health Malaysia
- All others who were involved directly or indirectly in the preparation of this document.

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GUIDELINES ON RADIATION SAFETY IN DENTISTRY

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1. INTRODUCTION

Dental radiography is a valuable diagnostic tool in modern dental practice and its judicious use allows dental practitioners to diagnose and monitor oral conditions that would otherwise be difficult to identify. However, the use of dental radiological procedures must be carefully managed, as all x-radiation has the potential to damage healthy cells and tissues¹. Although the radiation dose to individuals is low during an average dental radiological examination, repeated low dosages over time could pose a potential health hazard. However, to date, there is no known occurrence of malignant or genetic changes due to dental radiography². Nevertheless, it is incumbent upon all members of the dental profession to be vigilant and to exercise precautionary measures to ensure health and safety of patients, personnel and the public.

¹ Ministry of Science, Technology and Innovation, Malaysia. Malaysian Institute for Nuclear Technology Research Radiation Awareness. 1st ed. 2005, pp 13-23

² Abbott P. Are Dental Radiograph Safe? Aust Dent J 2000 ;45:(3):208-13

2. PURPOSE OF THIS DOCUMENT

This document aims to assist dental practitioners in complying with requirements on dental radiation safety. The guidelines are applicable to use of equipment designed for radiography of the teeth or jaws. These include the use of intra-oral image receptors, and panoramic and cephalometric radiography.

Compliance to requirements on radiation safety aims to ensure the following:

- minimise radiation risk to patients
- ensure adequate protection of dental personnel operating dental radiation equipment, and
- ensure adequate protection of members of the public in proximity to areas where such equipment is operated.

The relevant authorities that are responsible for ensuring compliance to the Atomic Energy Licensing Act 1984 (Act 304)³ and regulations on radiation safety are listed in **Appendix 1**.

³ Laws of Malaysia Act 304 - Atomic Energy Licensing Act 1984

To assist dental practitioners and auxiliaries to achieve the above, this document:

- lists the responsibilities of the dental practitioner
- specifies minimum standards for physical facilities in which dental radiation equipment is operated
- presents recommended practices to minimize radiation risk to personnel and patients, which includes ensuring proper and safe use of dental radiation equipment, and
- recommends quality assurance procedures for dental radiation safety.

3. RESPONSIBILITIES

The dental practitioner is ultimately responsible for radiation safety within the dental facility. Handling of the equipment, however, may be delegated to other personnel who are trained to undertake such procedures.

The responsibilities of the dental practitioner cover the following:

- ensuring that the dental radiation equipment comply with regulatory requirements
- establishing safe working area(s)
- establishing safe work procedures
- ensuring the equipment functions properly, and is maintained regularly, and

- ensuring that operators are properly trained to operate the equipment and to undertake proper procedures.

3.1 Ensuring the Dental Radiation Equipment Comply with Regulatory Requirements

3.1.1 Atomic Energy Licensing Act 1984 (Act 304)

The Atomic Energy Licensing Act 1984 (Act 304)³ is an Act to provide for the regulation and control of atomic energy, for the establishment of standards on liability for nuclear damage, and for matters connected or related to it.

Under Section 12(1) (b) of Act 304, without prejudice to the requirements of any other law, no person shall deal in, possess or dispose of any radioactive material, nuclear material, prescribed substance or irradiating apparatus, unless he is under Section 16(5), the holder of a valid license issued by the appropriate authority for such purpose and as specified in the license.

Regulations to Act 304

There are three regulations under Act 304 namely:

- The Radiation Protection (Licensing) Regulations 1986⁴
- The Atomic Energy Licensing (Basic Safety Radiation Protection) Regulations 2010⁵ and
- The Radiation Protection (Transport) Regulations 1989.

Under Regulation 6(1) of the Radiation Protection (Licensing) 1986 Regulations, a Class C license is defined as a ‘...license to manufacture, trade in, produce, process, purchase, own, possess, use, transfer, handle, sell or store irradiating apparatus...’.

The Atomic Energy Licensing (Basic Safety Radiation Protection) Regulations 2010, shall apply to all activities involving ionizing radiation. Regulation (42) states that dental practitioners shall ascertain whether the radiography is necessary before any exposure is administered to the patient. Regulations (17) and (18) cover the responsibilities of dental practitioners to monitor radiography work areas.

Guidelines and Circular under Act 304

The Ministry of Health Malaysia has produced a

⁴ Atomic Energy Licensing Act 1984 - Radiation Protection (Licensing) Regulations 1988

⁵ Atomic Energy Licensing Act 1984 - (Basic Safety Radiation Protection) Regulations 2010

document to provide assistance in complying with Act 304 in the form of the **Guidelines on the Procedure for Application of Class C License (MOH, 1995) - Guidelines to Obtain Class C License under the Atomic and Energy Licensing Act 1984 (Act 304).**⁶

An application for a new license, with a processing fee of RM15.00, may be made using the application form (*Borang LPTA/BP/3*). This form can be obtained from the following address:

*Ketua Pengarah
Lembaga Perlesenan Tenaga Atom (LPTA)
Kementerian Sains, Teknologi dan Inovasi
Batu 24, Jalan Dengkil, 43800 Dengkil,
Selangor, Malaysia.*

The LPTA forwards applications to the Director General of Health, Malaysia for the purpose of licensing. If all requirements are fulfilled, the applicant will then be required to pay a license fee of RM 100.00 for the first apparatus and RM20.00 for every additional apparatus. Payment of the license fee is to the Ministry of Health Malaysia. This license shall be renewed once in two years.

⁶ Ministry of Health Malaysia. Guidelines to Obtain Class C License under the Atomic Energy Licensing Act (Act 304), 2000

3.1.2 The Private Healthcare Facilities and Services Act 1998 (Private Medical Clinics or Private Dental Clinics) Regulations 2006

The special requirement for location and facilities of the diagnostic imaging services are outlined in Part XIII under Regulations 93(1) to 99(3) of the **Private Healthcare Facilities and Services Act 1998 (PHFSA '98)**.⁷ Dental practitioners are advised to ensure that they comply with the requirements stated in the regulations.

3.1.3 Equipment Requirements

All dental x-ray equipment shall fulfill the requirements stated in the Malaysian Standards (MS 838) Code of Practice for Radiation Protection (Medical X-ray Diagnosis), 2007.⁸

According to the Code of Professional Conduct of the Malaysian Dental Council (2008), all dental practitioners who store and operate machines for purposes of dental radiography and imaging shall abide by the Atomic Energy Licensing Act 1984, and any other such legislation governing the same.⁹

⁷ Law of Malaysia Act 586 - Private Healthcare Facilities and Services (Private Medical Clinics or Private Dental Clinics) Regulations 2006

⁸ Standards and Industrial Research Institute of Malaysia (SIRIM). Malaysian Standards (MS 838) Code of Practice for Radiation Protection (Medical X-ray Diagnosis), 2007

⁹ Malaysian Dental Council. Code of Professional Conduct, 2008, pp 18

3.2 Establishing Safe Working area

Ideally, dental radiography should be undertaken in an x-ray room or a radiography area. This may be a dental surgery, or an examination room, where the room / area is not used for other work while dental radiography procedures are conducted.

3.2.1 Dimensions of X-Ray Room / Area

The desired minimum internal dimensions of the room are:

- 2.0 meters (length) by 3.0 meters (width) for intra-oral dental x-ray, and
- 2.5 meters (length) by 3.5 meters (width) for panoramic and cephalometric x-ray⁶.

3.2.2 Structural Shielding

For dental radiography, the required thickness of shielding at doors and walls is:

- 1.0 mm lead equivalence (Pb eq) for intra-oral dental x-ray, and
- 1.5 mm Pb eq for x-ray OPG⁶.

3.2.3 Signs and Warning lights

A basic warning notice and ionizing radiation symbol

shall be provided on entrance door to any x-ray room / area. Additionally, a warning light to indicate when radiography is in progress should be provided outside the room.¹⁰

3.2.4 Protection for the Operator

The use of protective panels with glass (1 mm Pb eq) for staff to stand behind, or a protective apron for staff to wear is recommended⁸. Appropriate personal protective equipment should be worn in cases where an operator has to stand less than 2-3 meters from the radiation source.

3.3 Ensuring Safe Work Procedures

3.3.1 Written Procedures

Written instructions should be made available and displayed near the x-ray equipment to ensure that personnel are fully aware of the precautions to be taken. These instructions should detail the responsibility of identified personnel for exposure, positioning of operator and patient / public, use of protective devices, any restriction(s) on primary

¹⁰ European Commission. European Guidelines on Radiation Protection in Dental Radiology. The Safe Use of Radiographs in Dental Practice. Radiation Protection 136. Luxembourg, 2004

beam direction and personal monitoring arrangements, if appropriate.¹¹

3.3.2 Protection for the Patient/Assistant

The patient must at all times be provided with a lead apron with a lead equivalence of not less than 0.25 mm for reproductive organ protection. The use of a thyroid shield for children is important, especially during occlusal radiographic examination. In addition, protective aprons should be provided for any adult who provides assistance in supporting a patient.

Lead aprons must not be folded. Aprons should be correctly stored, for example, over a suitable hanger. The apron condition must be routinely checked, including a visual inspection at annual intervals.¹¹

Thyroid collars should be provided in those few cases where the thyroid may be in the primary beam.

Patient Positioning

The patient's head and the primary beam should be aligned such that the primary beam is not directed at

¹¹ Australian Government. Radiation Protection Series Publication No. 10. Code of Practice and Safety Guide. Radiation Protection in Dentistry. Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), 2005

the patient's reproductive organs and body¹².

Female Patient of Child-bearing Age

The dental practitioner/personnel undertaking dental radiography should always enquire into the pregnancy status of any female patient of child-bearing age.¹²

Whether or not the woman is known to be pregnant, the dental practitioner must always undertake radiological techniques that will ensure minimum exposure to any embryo or foetus that might be present.

3.3.3 Procedures Specific to Intra-Oral Radiography

Whenever practicable, techniques using film holders incorporating beam-aiming devices should be used for bitewings and periapical radiography.

If rectangular collimation is used, a beam-aiming device is essential for accurate alignment with the intra-oral film.¹¹

¹²National Radiological Protection Board UK. Guidance Notes for Dental Practitioners on the Safe Use of X-Ray Equipment. NRPB dental X-Ray Protection Services, 2001

3.3.4 Personal Radiation-Monitoring Devices for Personnel

If a personnel is likely to be exposed to a radiation dose exceeding 1 mSv in any one year, or the equivalent of a weekly workload that exceeds 100 intra-oral or 50 panoramic films¹², it is recommended that he/she be provided with personal radiation-monitoring devices, such as a film badge dosimeter or thermo-luminescent detector badge.

3.4 Ensuring Proper Function and Maintenance of Equipment

3.4.1 Maintenance and Testing

Maintenance and associated checks for intra-oral, panoramic and cephalometric x-ray apparatus shall be done **once every two years**.

Performance Test (Quality Control) and safety of the apparatus must be undertaken by an accredited Class H Consultant (medical physicist) for both intra-oral and OPG machines. An accredited Class H consultant shall possess Class H (certification) license issued by the Director General of Health Malaysia.⁴

3.4.2 Image Receptor, Processor and Viewer

For intra-oral radiography, the fastest available films consistent with satisfactory diagnostic results should be used. Intra-oral films of ISO speed group E, or faster, are preferred as they significantly reduce the amount of radiation by approximately 50%.¹¹

Where automatic processing is used, the processor should be properly cleaned and maintained. In the case of manual processing, maintenance should be done in accordance with the manufacturer's instructions.

In order to extract full diagnostic information from the films, a specially designed light-box should be used where the ambient lighting can be adjusted to appropriate levels.

3.5 Ensuring Training of Operators

The person who operates the x-ray equipment shall be a dental practitioner or a trained personnel approved by licensing authority¹³. All operators must:

- understand the requirements and recommendations

¹³ Kementerian Kesihatan Malaysia. Surat Pekeliling Ketua Pengarah Kesihatan Malaysia Bil 31/2010. Keperluan Mendapatkan Khidmat Personel Berkelayakan Sebagai Pegendali Radas Penyinaran Bagi Perkhidmatan Pergigian Di Bawah Akta Perlesenan Tenaga Atom 1984 (Akta 304) Bagi Maksud Perubatan. 2010.

- of these guidelines
- recognize the radiation hazards associated with their work and take measures to minimize them
 - have an understanding of safe working methods and appropriate techniques and procedures, and
 - eliminate unnecessary radiographic procedures.

3.5.1 Staff Welfare

A female operator should notify the dental practitioner upon knowledge that she is pregnant. If necessary, appropriate steps should be taken to adjust her duties. However, in general, there is no reason to remove pregnant operators from their duties of operating dental radiological equipment provided all protective measures are adhered to¹⁴.

4. QUALITY ASSURANCE

The purpose of Quality Assurance (QA) is to ensure consistently adequate diagnostic information, while radiation doses are controlled to be **As Low As Reasonably Achievable** – the ALARA principle.

¹⁴ Health Canada, Recommended Safety Procedures for the Use of Dental X-Ray Equipment. Radiation Protection in Dentistry. Safety Code 30, 2000

It is essential that dental practitioners observe the basic principles of radiation protection that is,

- maximize the distance from the source,
- minimize time of exposure, and
- shield the radiation source.

This implies that no dose should be acceptable if it can be avoided or is without benefit.¹⁵

The essential procedures suited to dental radiology within a programme will relate to:

- Quality control (QC) of equipment operation and baseline performance of radiographic equipment,
- Image quality – monitoring and analysis of film reject rate - corrective action should be taken if the reject rate is more than 10%, and
- Professional education on use of x-ray equipment, hazard of ionising radiation and radiation safety.

4.1 Establishing Equipment Performance / Operation

Quality control procedures include ensuring the dental x-ray equipment, protective devices and film processing equipment function properly and adequately. This includes replacement, repair,

¹⁵ Ministry of Health Malaysia. Circular on additional requirements that need to be complied with entitled Licensing Requirements Under The Atomic Energy Licensing Act 1984 (Act 304) For Specialized Diagnostic Radiology Services Provided By Private Hospitals/Radiology Clinics No (5)d/m.KKM 153(13/172)Bhg2 (MOH, 1999)

upgrading and calibration of equipment, where necessary. Technical evaluation of the equipment shall be certified by a supplier.

Technical evaluation should include the following:

Dental X-Ray Equipment

- Calibration of equipment
- Proper radiation beam alignment
- Mechanical and electrical performance
- Inspection and replacement of worn or broken components
- Following the manufacturer's preventive maintenance schedule.

Protective Devices

- Inspection of protective devices, including lead shields, aprons and thyroid shield.

Films Processing Equipment

- Inspection of storage tanks, condition of processing equipment and maintenance schedule.

4.2 Ensuring Proper Film Storage

Unexposed x-ray films should be stored in a container that is adequately shielded against radiation or is placed in an area remote from any x-ray unit and away from excessive heat, humidity or chemical contamination.¹⁶

4.3 Establishing Administrative Procedures

Keeping records

An up-to-date inventory of each item of x-ray equipment is important, and should be available at each practice. The inventory should contain the following details:

- Name of manufacturer
- Model number
- Serial number
- Year of manufacture
- Year of installation
- Maintenance records

¹⁶ Australian Government. Code of Practice and Safety Guide. Radiation Protection in Dentistry. Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) 2005. Radiation Protection Series Publication No. 10

5. PROCEDURES TO MINIMISE RADIATION EXPOSURE TO PERSONNEL

The procedures below summarize the steps to keep to a minimum radiation exposure to personnel and others.

- a. Dental radiographic equipment must only be operated by personnel trained in its safe use.
- b. The controlled area must not be used for more than one radiological investigation at the same time.
- c. All persons, except for the patient and those whose presence are required, must leave the room when a radiographic examination is in progress.
- d. Operators must keep as far away from the primary radiation beam as possible.
- e. All operators must use protective devices.
- f. The operation of the x-ray equipment should be controlled from outside the controlled area or behind a protective screen.
- g. The dental film should be kept in position with a holding device whenever possible. If unavailable the film should be held in place by the patient himself/herself. The dental personnel must not hold

the film in place for the patient during the procedure.

- h. Where there is a need to support children or weak patients, holding devices should be used. If parents, escorts or personnel are called to assist, they must be provided with protective clothing/aprons and be positioned to avoid the primary beam. No one must regularly perform these duties.
- i. All x-ray tube housing must not be held by hand during operation.

6. PROCEDURES TO MINIMISE RADIATION EXPOSURE TO PATIENTS

It is the responsibility of the dental practitioner/operator to ensure the lowest practical dose to the patient. A summary of the essential procedures are listed below.

- a. Every effort must be made to avoid unnecessary radiological examination and when required, it is essential that patients be protected from excessive radiation exposure during examination.
- b. A radiographic examination should only be for the purpose of obtaining diagnostic information about the patient's conditions. Routine or screening examination without prior clinical assessment should

not be prescribed.

- c. It should be determined whether there have been previous radiographic examinations which might make further investigations unnecessary. Where practicable, a patient's clinical records in one clinic should detail out all radiographic examinations that have been undertaken.
- d. Repeat radiographic examinations should not be prescribed just because a radiograph is not at its 'best' diagnostic quality. Often, the information may provide the required clinical information without having to repeat the investigation.
- e. It must be emphasized that precautions to minimize radiation exposure should be taken all the time for women of child-bearing age, as a woman may be unaware of her pregnancy status.
- f. The patient must be provided with a lead apron at all times for reproductive organ protection. The use of a thyroid shield for children is especially important, especially during occlusal radiographic examination.
- g. The patient's head should be positioned in such a way that the primary beam is not directed at the reproductive organs, and is not unnecessarily irradiating the patient's body.

- h. A fast speed film (speed group E or faster) as classified by the International Organization for Standardization (ISO) should be used.

7. CONCLUSION

Even though radiation dose in dental radiography is very low, it is important for the dental practitioners to follow these guidelines to ensure all dental personnel, patients and public are protected from unnecessary ionising radiation. Dental practitioners should not be complacent about the low risks of dental radiography. They are professionally responsible to use radiography appropriately in their practices and to maintain good, safe radiation procedures at all times.

STATUTORY AUTHORITIES

Further advice or assistance may be obtained from the following authorities:

1. Principal Director of Oral Health
Oral Health Division
Ministry of Health, Malaysia
Level 5, Block E10, Complex E
Federal Government Administrative Centre
62590 Putrajaya
Malaysia
Tel: 03-8883 4215 Fax: 03-8888 6133

2. Director
Engineering Services Division
Ministry of Health, Malaysia
Level 2-5, Block E6, Complex E
Federal Government Administrative Centre
62590 Putrajaya
Malaysia
Tel: 03-8883 2346/50 Fax: 03-8888 6184

3. *Lembaga Perlesenan Tenaga Atom*
Kementerian Sains, Teknologi dan Inovasi,
Batu 24, Jalan Dengkil, 43800 Mukim Dengkil,
Selangor, Selangor
Malaysia
Tel: 03-8922 5888 Fax: 03-8922 3685