CDSBC

STANDARDS & GUIDELINES

Dental Radiography

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Standards and guidelines inform practitioners and the public of CDSBC's expectations for registrants. This document primarily contains standards, which are, by definition, mandatory and must be applied. Standards are clearly identified by mandatory language such as "must" and "required." This document also contains guidelines that are highly recommended but – while being evidence of a standard – are not, strictly speaking, mandatory. Guidelines contain permissive language such as "should" and "may."

1. Dental Radiography

The purpose of this document is to remind dentists of the expectations that the College has regarding dental radiation. The frequency of a radiological examination is a matter of clinical judgment, and the selection of equipment and techniques used is the decision of the dentist. Compliance with Health Canada's Safety Code 30 and the ALARA (As Low as Reasonably Achievable) principle is compulsory. The amount of patient radiation exposure must be kept as low as possible given current accepted radiological practice.

Radiographs* are necessary for the evaluation and diagnosis of many oral conditions and diseases. Radiographs should be specific to the needs and requirements of each particular patient.

Radiographs cannot be exposed without a prescription.

This document recognizes that in Canada both general and specialist dentists receive training in interpreting radiographs. The dentist who is prescribing the radiographs is professionally responsible/accountable for everything in the field of view. A referral must be made if the dentist notices an abnormality beyond his/her competence or ability to interpret regardless of where in the field of view it appears, or if the field of view exceeds their ability to properly interpret.

Registrants are referred to the following documents for the guidelines and standards CDSBC expects its registrants to follow when utilizing dental radiography:

- Safety Code 30 (Health Canada)
- B.C. Centre for Disease Control (BCCDC) Dental X-Ray Facts
- SEDENTEXCT(European Commission on Radiation Protection)
  The SEDENTEXCT document is a long and detailed one; it should be read in its entirety. See Appendix A for the highlights of the SEDENTEXCTdocument.

1.1 Guiding Principles

1. After confirming there are no recent/adequate radiographs available, a dentist may prescribe radiographs based on a clinical examination to develop a diagnosis and form a treatment plan.
2. The justification for taking dental radiographs must be determined by a need to obtain specific information not available from other sources. Taking radiographs on request by third parties for administrative purposes only is not recommended.
3. Operators must be reminded to select a technique or method that will permit the production of radiographs or images of an acceptable diagnostic quality with minimum exposure of the patient to radiation.
4. The dentist must ensure those exposing patients to radiation have the knowledge, skills and competency to perform this service. Those exposing patients to radiation must hold registration, certification or a radiography designation with CDSBC and must be fully trained in the use of each piece of equipment they are being asked to utilize.
5. The decision to repeat radiographs should not be based on ideal technical requirements, but rather on a lack of required diagnostic information.
6. Appropriate shielding must always be used when exposing patients to radiation.

*For the purpose of this document radiographs includes images

2. References

1. Safety Code 30 (Health Canada)
   http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/99ehd-dhm177/index-eng.php
2. B.C. Centre for Disease Control (BCCDC) Dental X-Ray Facts
   http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/EH/RPS/DentalXRayFacts.pdf
3. SEDENTEXCT (European Commission on Radiation Protection)
   http://www.sedentexct.eu/content/guidelines-cbct-dental-and-maxillofacial-radiology

Appendix A

Highlights from the Evidence-Based Guidelines on Cone Beam CT for Dental and Maxillofacial Radiology (SEDENTEXCT Project)

This document features highlights from the document *Radiation Protection No 172 – Cone beam CT for dental and maxillofacial radiology (Evidence-based guidelines)* published in 2011 by the SEDENTEXCT project.

The SEDENTEXCT document in its entirety has been incorporated by reference as part of the standards for B.C. The highlights included in this summary document are therefore not a complete list. The reader should be familiar with the entire document in order to understand the full range and context.

NOTE: The numbering used below refers to the sections of the document from which the highlights were drawn (SEDENTEXCT 2011).

1. INTRODUCTION AND GUIDELINE DEVELOPMENT

1.1 Imaging in dentistry and the dental and maxillofacial specialties

All stakeholders have a responsibility to deliver radiographic technology to patients in a responsible way, so that diagnostic value is maximized and radiation doses kept as low as reasonably achievable.

3. BASIC PRINCIPLES

1	CBCT examinations must not be carried out unless a history and clinical examination have been performed
2	CBCT examinations must be justified for each patient to demonstrate that the benefits outweigh the risks
3	CBCT examinations should potentially add new information to aid the patient's management
4	CBCT should not be repeated 'routinely' on a patient without a new risk/benefit assessment having been performed
5	When accepting referrals from other dentists for CBCT examinations, the referring dentist must supply sufficient clinical information (results of a history and examination) to allow the CBCT practitioner to perform the justification process
6	CBCT should only be used when the question for which imaging is required cannot be answered adequately by lower dose conventional (traditional) radiography
7	CBCT images must undergo a thorough clinical evaluation ('radiological report') of the entire image dataset

8	Where it is likely that evaluation of soft tissues will be required as part of the patient's radiological assessment, the appropriate imaging should be conventional medical CT or MR, rather than CBCT
9	CBCT equipment should offer a choice of volume sizes and examinations must use the smallest that is compatible with the clinical situation if this provides less radiation dose to the patient
10	Where CBCT equipment offers a choice of resolution, the resolution compatible with adequate diagnosis and the lowest achievable dose should be used
11	A quality assurance programme must be established and implemented for each CBCT facility, including equipment, techniques and quality control procedures
12	Aids to accurate positioning (light beam markers) must always be used
13	All new installations of CBCT equipment should undergo a critical examination and detailed acceptance tests before use to ensure that radiation protection for staff, members of the public and patient are optimal
14	CBCT equipment should undergo regular routine tests to ensure that radiation protection, for both practice/facility users and patients, has not significantly deteriorated
15	Or staff protection from CBCT equipment, the guidelines detailed in Section 6 of the European Commission document 'Radiation Protection 136. European Guidelines on Radiation Protection in Dental Radiology' should be followed
16	All those involved with CBCT must have received adequate theoretical and practical training for the purpose of radiological practices and relevant competence in radiation protection
17	Continuing education and training after qualification are required, particularly when new CBCT equipment or techniques are adopted
18	Dentists responsible for CBCT facilities who have not previously received 'adequate theoretical and practical training' should undergo a period of additional theoretical and practical training that has been validated by an academic institution (University or equivalent). Where national specialist qualifications in DMFR exist, the design and delivery of CBCT training programmes should involve a DMF radiologist

*19	For dento-alveolar CBCT images of the teeth, their supporting structures, the mandible and the maxilla up to the floor of the nose (e.g. 8cm x 8cm or smaller fields of view), clinical evaluation ('radiological report') should be made by a specially trained DMF Radiologist or, where this is impracticable, an adequately trained general dental practitioner*
*20	For non-dento-alveolar small fields of view (e.g. temporal bone) and all craniofacial CBCT images (fields of view extending beyond the teeth, their supporting structures, the mandible, including the TMJ, and the maxilla up to the floor of the nose), clinical evaluation ('radiological report') should be made by a specially trained DMF Radiologist or by a Clinical Radiologist (Medical Radiologist)*

**CDSBC Note: The SEDENTEXCT document was written with a European context. In Canada both general and specialist dentists receive training in interpreting radiographs. The dentist who is prescribing the radiographs is professionally responsible/accountable for everything in the field of view. A referral must be made if the dentist notices an abnormality beyond his/her competence or ability to interpret regardless of where in the field of view it appears, or if the field of view exceeds their ability to properly interpret.*

4. JUSTIFICATION AND REFERRAL CRITERIA

4.2 The developing dentition

Justification of X-ray examinations in children is especially important because of the higher risks associated with exposure in children (see section 2.4).

CBCT may be indicated for the localized assessment of an impacted tooth (including consideration of resorption of an adjacent tooth) where the current imaging method of choice is conventional dental radiography and when the information cannot be obtained adequately by lower dose conventional (traditional) radiography.

4.2.2 *Generalized application of CBCT for the developing dentition*

Large volume (craniofacial) CBCT, imaging at least the entire facial skeleton, is currently being used as a routine tool for orthodontic-related radiological assessment by some clinicians.

As in our previous review, the Panel felt that much of the literature on using large volume CBCT for routine orthodontic diagnosis and treatment was anecdotal, case report- and opinion-based, with a lack of evidence of significant clinical impact.

Large volume CBCT should not be used routinely for orthodontic diagnosis.

Research is needed to define robust guidance on clinical selection for large volume CBCT in orthodontics, based upon quantification of benefit to patient outcome.

4.3.3 *Assessment of periapical disease*

CBCT is not indicated as a standard method for identification of periapical pathosis.

Limited volume, high resolution CBCT may be indicated for periapical assessment, in selected cases, when conventional radiographs give a negative finding when there are contradictory positive clinical signs and symptoms.

4.3.4 *Endodontics*

CBCT is not indicated as a standard method for demonstration of root canal anatomy.

Limited volume, high resolution CBCT may be justifiable for selected cases, where endodontic treatment is complicated by concurrent factors, such as resorption lesions, combined periodontal/endodontic lesions, perforations and atypical pulp anatomy.

4.3.5. *Dental trauma*

Limited volume, high resolution CBCT is indicated in the assessment of dental trauma (suspected root fracture) in selected cases, where conventional intraoral radiographs provide inadequate information for treatment planning.

4.4 Surgical applications

4.4.1 *Exodontia*

Where conventional radiographs suggest a direct inter-relationship between a mandibular third molar and the mandibular canal, and when a decision to perform surgical removal has been made, CBCT may be indicated.

4.4.2 *Implant dentistry*

CBCT is indicated for cross-sectional imaging prior to implant placement as an alternative to existing cross-sectional techniques where the radiation dose of CBCT is shown to be lower.

For cross-sectional imaging prior to implant placement, the advantage of CBCT with adjustable fields of view, compared with MSCT, becomes greater where the region of interest is a localized part of the jaws, as a similar sized field of view can be used.

4.4.3 *Bony pathosis*

Limited volume, high resolution CBCT may be indicated for evaluation of bony invasion of the jaws by oral carcinoma when the initial imaging modality used for diagnosis and staging (MR or MSCT) does not provide satisfactory information.

4.4.4 *Facial trauma*

For maxillofacial fracture assessment, where cross-sectional imaging is judged to be necessary, CBCT may be indicated as an alternative imaging modality to MSCT where radiation dose is shown to be lower and soft tissue detail is not required.

4.4.5 Orthognathic surgery

CBCT is indicated where bone information is required, in orthognathic surgery planning, for obtaining three-dimensional datasets of the craniofacial skeleton.

4.4.6 Temporomandibular joint

Where the existing imaging modality for examination of the TMJ is MSCT, CBCT is indicated as an alternative where radiation dose is shown to be lower.

9. TRAINING

9.1 Roles and responsibilities

All those involved with CBCT must have received adequate theoretical and practical training for the purpose of radiological practices and relevant competence in radiation protection.

Continuing education and training after qualification are required, particularly when new CBCT equipment or facilities are adopted.

Dentists and dental specialists responsible for CBCT facilities who have not previously received "adequate theoretical and practical training" should undergo a period of theoretical and practical training that has been validated by an academic institution (University or equivalent) [*CDSBC added:*] or by an appropriate regulatory body.

Board Approved

- September 2015

Date Published

- September 2015

Originating Committee

- Quality Assurance Committee

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Dental X-Ray

BC Centre for Disease Control
An agency of the Provincial Health Services Authority
Radiation Protection, Environmental Health Services

Revised: October 2012

Radiography is one of the most useful and powerful diagnostic tools available to the dental practitioner. The use of x-rays as a standard diagnostic procedure is well established in the profession. This use places an obligation on the dental practitioner who must weigh the benefits of additional diagnostic information against the risk from radiation exposure to the patient.

In keeping with current radiation protection philosophy, exposure to all persons should be kept **As Low As Reasonably Achievable (ALARA)**. Therefore, it is imperative that radiographic procedures are optimized to provide acceptable diagnostic information to the dental practitioner with the minimum radiation exposure to the patient and dental office staff.

The information contained in this booklet is aimed primarily at dental office staff, to help them achieve and maintain an acceptable level of radiation protection.

Introduction

This booklet provides the dental practitioner, dental clinic staff and patients with a number of facts on the use of x-rays in dentistry. These facts have been compiled into eight sections, as follows:

This is followed by a review of the methods that can be used to help keep radiation exposures to the patient and other persons **As Low As Reasonably Achievable**. The question of who decides whether an x-ray should be taken is also discussed. A glossary of the commonly used terms in the x-ray protection field is included at the back of this booklet.

1. The Dental X-ray Tube

To help you visualize the workings of the x-ray tube, please see ***Figure 1***.

a) The filament is heated by the filament current. Electrons are emitted by the hot filament and travel to the anode. This flow of electrons from the cathode to the anode is called **TUBE CURRENT** and is measured in units of milliamperes (mA). The tube current determines the **QUANTITY** of x-radiation, which will be produced for a given applied high voltage.

b) A high voltage potential, measure in kilovolts peak (kVp), is maintained during the exposure between the cathode and the anode. The higher this voltage the faster the electrons will travel to the anode. Consequently, the x-rays produced will have a higher energy and, therefore, will be capable of greater penetration. Thus, kVp determines the **QUALITY** of the radiation emitted. A change in the kilovoltage will also produce a change in the **AMOUNT** or **INTENSITY** of the x-ray beam.

c) When an electron strikes the anode target material the electrons will be slowed down or stopped, resulting in the emission of x-rays with varying energies. The heavier the target material the greater the intensity of the emitted radiation.

d) The target material in an x-ray tube is usually made of tungsten. However, since 99% of the energy of the bombarding electrons manifests itself as heat, the target has a copper backing for more efficient cooling of the tube.

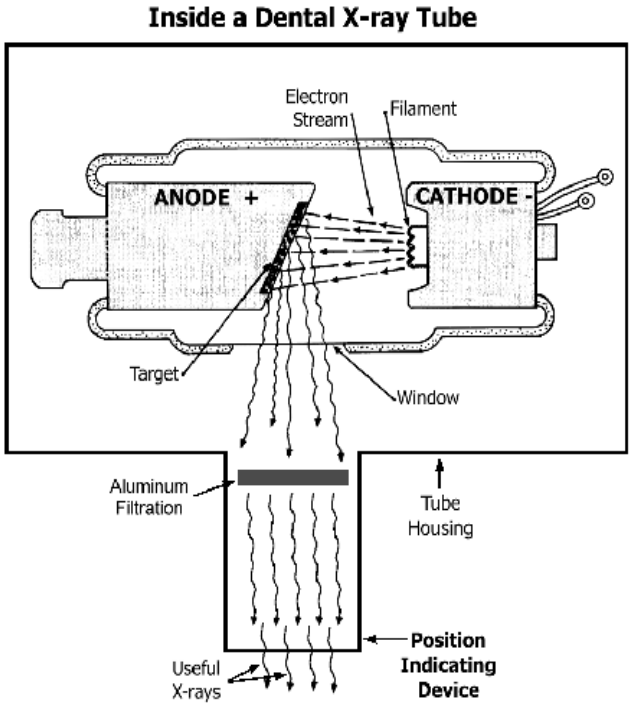
e) The useful beam of x-rays emitted from the tube contains a mixture of low and high energy x-rays (soft and hard x-rays respectively). Aluminum filters and high kVp are required to increase the ratio of the useful hard x-rays. Very soft x-rays are not likely to penetrate the patient and, hence, are of no use in producing an image on dental x-ray film. To remove these very soft x-rays from the useful beam, a minimum thickness of 1.5mm of aluminum (or equivalent) is required for the tube operating up to 70kVp. For tubes operating above 70kVp, 2.5mm of aluminum (or equivalent) is required.

Figure 1

f) The x-ray tube housing is fitted with a **Position Indicating Device** (**PID**) through which the useful x-ray beam passes. Inside the **Position Indicating Device** (**PID**), where it attaches to the tube housing, is a beam collimating device, which restricts the size of the useful beam, to 7cm at the end of the PID. The **PID** must maintain a minimum distance of 18cm between the x-ray source and the patient's skin.

The maximum size of the emerging x-ray beam at the end of the **PID** of an intra-oral film x-ray unit must not exceed 7 cm.

Modern dental x-ray equipment imported or sold in Canada is required under federal law to meet these standards, and should not be an issue for users.



2. The X-ray Beam

When a beam of x-rays reaches the patient, several things happen:

a) Most of the useful x-ray beam is absorbed in the tissues of the area under investigation.

b) Some of the x-rays are scattered by this tissue.

c) The transmitted beam then reaches the dental x-ray film placed in the mouth and produces a latent image of the teeth being x-rayed.

d) The remaining beam is then either absorbed or scattered by the other tissues of the mouth.

e) Only a very small amount of x-ray radiation passes through the patient without interaction.

3. Effects on the Patient

For routine dental x-ray procedures, the amount of x-ray exposure is small and will not cause any immediate, acute health effects on the patient.

Since x-rays are a type of **IONIZING RADIATION**, it is assumed, however, that any exposure has associated with it a very small additional health risk.

However, if the radiation exposure is increased, it is assumed that there is an increase of the added health risk. Therefore, it is important to keep radiation exposures to **As Low As Reasonably Achievable**, bearing in mind the benefits the patient derives from the diagnostic procedure. Causes of additional exposure are:

a) Improper processing of the dental image.

b) Repeat dental x-ray film due to incorrect positioning of the x-ray tube or selection of inappropriate technique factors.

c) Unnecessary requests for dental radiographs (i.e. requests in the absence of prior clinical evaluation).

4. Inside the X-ray Room

Whenever x-rays are being taken, a small percentage of the useful beam of radiation scatters in many directions. Personnel in the vicinity can receive radiation exposure even though they are not exposed to the primary beam. Chronic exposure to this stray radiation is undesirable and must be avoided. Therefore, only the patient should be inside the x-ray room during an exposure.

The operator should be able to stand outside the room or be as far as possible from the x-ray tube while operating the control, and be able to view the patient during the exposure.

Protective aprons are recommended for use by the patient in order to provide protection against scattered radiation as well as leakage radiation coming through the tube housing. A thyroid collar, to cover the neck region, is also recommended.

5. Image Processing

Accurate processing the dental image is critical in obtaining an acceptable diagnostic image on with the lowest radiation exposure necessary.

By following image processing instructions for digital or film, issued by the manufacturer, exposures can be kept to within acceptable ranges. **Table 1** shows the acceptable x-ray exposure ranges for two common film groups ("D" series and "E" series) as a function of the kilovoltage selected on the x-ray unit. When a radiation protection survey is carried out, the exposure can be measured for the technique you are using for a standard bitewing x-ray. The result is then compared with the appropriate lower/upper mR limit values for the kVp and film type, as shown in **Table 1**.

To help you evaluate your film processing, the Radiation Protection Services has produced a "self-help" guide. This guide is provided in Section 6 of this booklet, as a convenient reference and aid to helping dental facilities establish and maintain the correct procedures for image processing, to achieve good quality images and prevent unnecessary exposure to patients and staff.

Table 1

"D" Speed Film *

kVp	Lower mR Limit	Upper mR Limit
50	425	550
55	350	500
60	310	440
65	270	400
70	240	350
75	170	260
80	150	230
85	130	200
90	120	180
95	110	160
100	100	140

*** Exposure conditions:**

- 10mA, 20cm SSD
- 50-70kVp, 1.5mm Al
- 71-100kVp, 2.5mm Al

"E" Speed Film **

kVp	Lower mR Limit	Upper mR Limit
50	220	280
55	190	270
60	165	230
65	140	200
70	120	170
75	100	140
80	90	120
85	80	105
90	70	90
95	60	80
100	50	70

**** Exposure conditions:**

- 10mA, 30cm SSD
- 50-70kVp, 1.5mm Al
- 71-100kVp, 2.5mm Al

6. Checking Your Film Processing

If manual processing is used, make sure that the dental x-ray film is immersed in the developer for the correct amount of time. Otherwise, if the development time is reduced, an increase in exposure must be delivered to the dental x-ray film, and therefore to the patient, to compensate for under-development.

Where automatic processing is used, it is important to follow the manufacturer's recommendations for maintenance and housekeeping to achieve optimal film quality.

The correct processing of the radiographic film is critical to ensure the lowest radiation exposure required to produce an acceptable image (or radiograph). Owners of x-ray equipment should refer this problem to your staff members who are trained in Standardized Darkroom Technique and can evaluate all the items discussed below. Others should refer to their film and chemistry supplier representatives for technical assistance.

Under development of the films in the developer tank leads to **overexposure** of the patient, as well as increased levels of stray radiation exposing staff. The problem with under development compensated for by over-exposure is that the radiograph appears to have received the correct exposure and, therefore, provides no radiographic evidence of over-exposure. To determine if you are over-exposing your patients, ask yourself the following questions:

1. Are you using your developer for more than approximately one month? ❒ yes ❒ no

2. Are you ignoring manufacturer's instructions for preparing developer and fixer? ❒ yes ❒ no

3. Have you shortened recommended developing times and/or reduced temperatures from what the film manufacturer recommends (applies to both manual and automatic processors)? ❒ yes ❒ no

If you answered **YES** to questions 1, 2 or 3 you may be over-exposing your patients and under-developing the films.

4. Do you measure the developer temperature daily with a darkroom thermometer to ensure developer temperature is at the recommended setting? ❒ yes ❒ no

5. Are you replenishing developer/fixer as recommended by the chemistry and/or film manufacturer? ❒ yes ❒ no

If you answered **NO** to questions 4 or 5 you may be over-exposing your patient and under-developing the films.

Are there any clues to help you with these concerns? Try the following:

A. Make up new developer according to manufacturer's directions. If the new developer produces dark radiographs, then you are likely over-exposing your films. Problem: the developer was allowed to get too old.

B. Make up chemicals according to manufacturer's instructions. If you get dark films, then you are likely over-exposing the patient and the film. Problem: the previous developer was not made up correctly.

C. Are you 'sight developing'? That is, viewing the film **during** developing and shortening developing times to get correct density? If you are, you are likely over-exposing the patient and the film. Try correct time/temperature developing, i.e. standardized darkroom technique. If you get dark films, you are likely over-exposing.

D. Bring developer up to manufacturer's recommended temperature. If films are dark, you are likely over-exposing.

If you are producing dark films when trying any of **A** through **D** above, reduce the timer setting automatic exposure controls to get the correct exposure to the film. This will reduce exposures to the patient. Reducing exposures to the patient may also result in **reduced exposures to staff**.

7. The Radiation Protection Survey

When a radiation protection survey is carried out at a dental facility, its purpose is to determine whether an acceptable standard of protection is being provided for the patients and all dental facility personnel, as well as for any other persons in the vicinity of the facility.

To this end, the inspection focuses on the following items:

1. *Technique factors* used are evaluated to determine the radiation exposure to the patient, and whether the exposure is within the acceptable range for the techniques used (see ***Table 1*** on page 6). This will determine if the x-ray unit and the film processing system are performing satisfactorily.
2. The *safeguards* that are in place to ensure the safe use of the dental x-ray unit for the protection of the operator and other personnel close by.
3. The *intensity of stray radiation* occurring outside the protective barriers or at other important locations where the general public may have access.

Where any deficiencies are identified, they are brought to the attention of the dental practitioner and the appropriate professional association/college, that are responsible for ensuring that corrective action is carried out. Quality control and assurance is achieved through an on-going partnership program, between the dental practitioner, the association/college and the Radiation Protection, Environmental Health Services, BC Centre for Disease Control, which readily identifies changes that could lead to a reduction in standards and, therefore, increased exposure.

Some of the more common problem areas and ways to correct them are identified in the **Review**.

8. WorkSafeBC (WSBC)

Requirements for protection of workers against hazards is specified in the *WSBC Occupational Health and Safety Regulation (BC Regulation 296/97)*. The owner of x-ray equipment must ensure that exposure of staff to ionizing radiation is kept **As Low As Reasonably Achievable**, below the maximum permissible dose. In addition, the *Regulation* specifies an Action Level of 1mSv/year for workers. When workers exceed, or are likely to exceed, the Action Level, the *Regulation* requires the employer to carry out certain tasks. Please consult the *Regulation* for details.

Review

a) By correcting any errors in image processing, the x-ray technique factors can be changed to reduce exposure to both patients and staff.

b) For film processing, to reduce unsharpness a shorter timer setting may be selected by adjusting the other technique factors (i.e. mA and/or kVp).

c) An increase in Position Indicating Device (PID) length might be required to ensure that a minimum source-to-skin distance of 18cm is obtained.

d) Suitable collimation of the x-ray beam is necessary to restrict the useful beam size to not more than 7cm at the end of the Position Indicating Device (PID), for intra-oral film x-ray units.

e) An inaccurate or inconsistent timer (particularly an older type mechanical timer) must be replaced with a modern, reliable electronic timer.

f) When making an exposure, the operator should stand in a position outside the x-ray room or as far as possible from the x-ray unit and be able to **view the patient** while remaining **behind a barrier during the exposure**.

g) The ultimate objective is to keep radiation levels to both the patient and operator **As Low As Reasonably Achievable** (**ALARA**), while achieving satisfactory diagnostic images.

Responsibility

NOTE: Only after careful oral examination of the patient, the dental practitioner may recommend taking an x-ray image to verify the diagnosis or to obtain more information for planning treatment. It is the dental practitioner's responsibility to weigh the reasons for and against the taking of an x-ray and to advise the patient accordingly. Nevertheless, the final decision for having an x-ray rests with the patient.

Glossary

Commonly Used Terms:

Absorbed Dose: Absorbed dose is the measure of the amount of energy absorbed from radiation exposure by material at the point of interest. This is dependent upon the nature of the absorbing material as well as on the quality of the radiation. The original unit of absorbed doses is the rad. The International System of Units (SI) uses a unit called Gray (Gy). The relationship between the two units is as follows:

1	Gy	=	100	rad	1	rad	=	10 mGy
1	mGy	=	100	mrad	1	mrad	=	10 µGy

Collimation: The restriction of the useful beam to the appropriate area size.

Equivalent Dose: Equivalent dose is the measure of the potential for biological harm, associated with the absorbed dose arising from exposure to radiation. The original unit of equivalent dose is the rem. The SI system unit of equivalent dose is the SIEVERT (Sv). The relationship between the two units is as follows:

1	Sv	=	100	rem	1	rem	=	10 mSv
1	mSv	=	100	mrem	1	mrem	=	10 µSv

Exposure: Exposure is the measure of the quantity of radiation delivered at a particular point. The original unit of exposure is the Roentgen (R). The SI unit of exposure is the Coulomb/Kilogram (C/kg). The relationship between the two units is as follows:

1	C/kg	=	3876	R	1	R	=	258 µC/kg
1	mC/kg	=	3876	mR	1	mR	=	258 nC/kg

Filter; Filtration: Material in the useful beam that absorbs preferentially the less penetrating radiation.

Protective Barrier: A body of material (e.g. a wall) used to shield against, or reduce the intensity of, radiation to an acceptable level.

Radiation – Ionizing: Radiation capable of removing one or more electrons, directly or indirectly, by interaction with atoms.

Leakage Radiation	All radiation, except the useful beam, coming from within the tube housing.
Scattered Radiation	Radiation deviated in direction during passage through matter; it may also have been modified by a decrease in energy.
Stray Radiation	The sum of leakage and scattered radiation.
Useful Beam	Radiation which passes through the window, aperture, **Position Indicating Device** (**PID**) and/or other collimating device of the tube housing.

Technique Factors: Variables of kVp, mA, time and distance factors that the operators may select for a particular dental radiographic examination.

X-rays: X-rays are a form of ionizing radiation produced when high energy electrons are slowed down or stopped by the target material of an x-ray tube.

For more information please contact:

Radiation Protection
Environmental Health Services
BC Centre for Disease Control
Main Floor, 655 12th Ave W
Vancouver BC V5Z 4R4

Telephone: 604.707.2442
Facsimile: 604.707.2441
Email: rpsinfo@bccdc.ca
Website: http://www.bccdc.ca

Additional information is available in ***"Safety Code 30, Radiation Protection in Dental Practice, Recommended Safety Procedures for Installation and Use of Dental X-Ray Equipment"***. Health Canada, Canadian Publishing Centre, Ottawa Ontario K1A 0S9 or from the Health Canada website:

http://www.hc-sc.gc.ca/ehp/ehd/catalogue/rpb_pubs/99ehd177.pdf

For information on the *WSBC Occupational Health & Safety Regulation* (particularly Sections 7.32 - 7.45 on Ionizing Radiation) contact the WSBC website:

http://www2.worksafebc.com/publications/OHSRegulation/Part7.asp