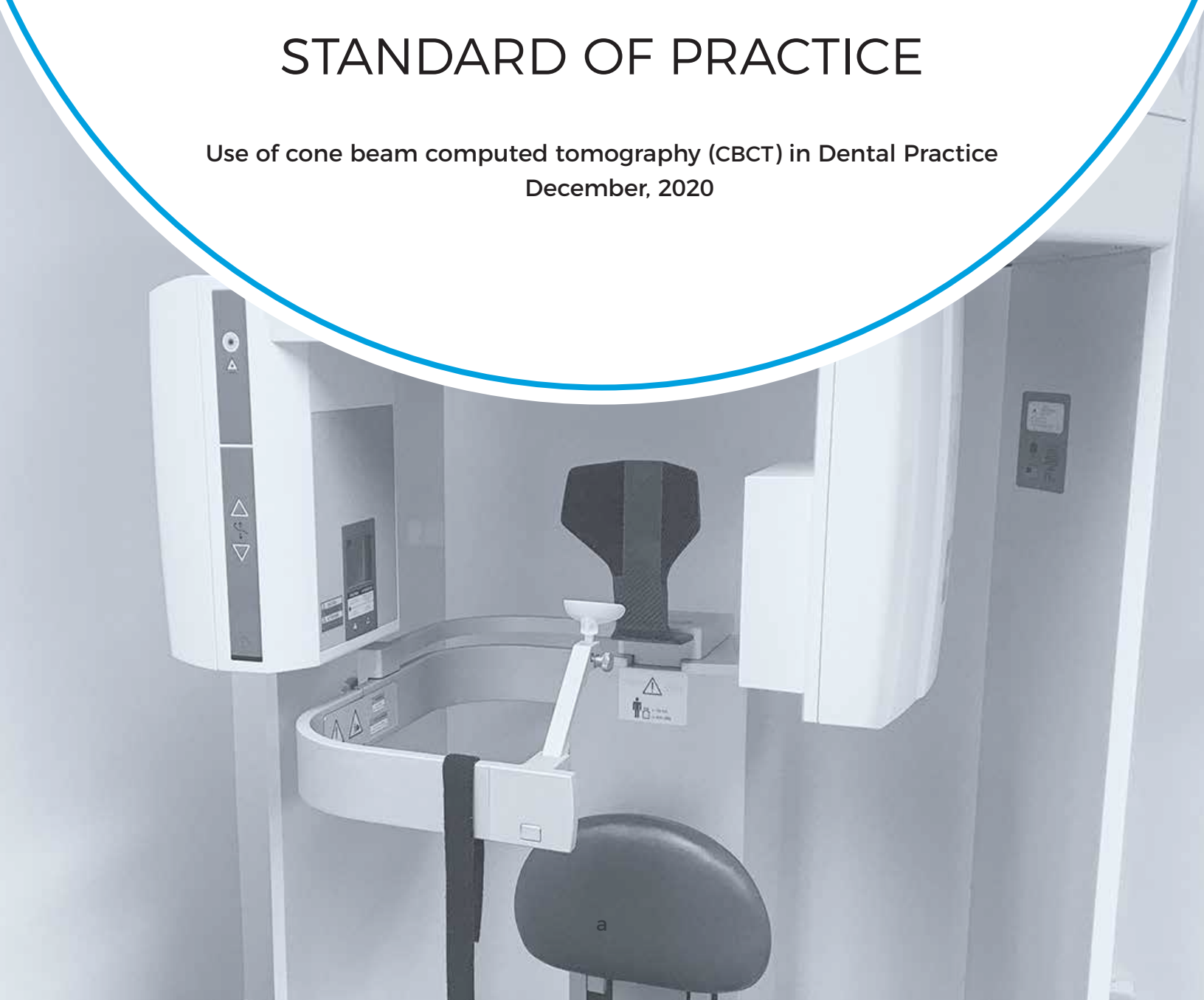
Provincial Dental Board
of Nova Scotia

STANDARD OF PRACTICE

Use of cone beam computed tomography (CBCT) in Dental Practice
December, 2020



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Introduction

Dental cone beam computed tomography (CBCT) scanners are a significant addition to the imaging armamentarium available for the investigation of dental patients. CBCT technology is constantly improving and, as a result, there is much interest on the part of dentists to take advantage of this imaging modality for the diagnosis and treatment of their patients.

However, like conventional dental radiography, dental CBCT scanners utilize ionizing radiation, which can increase an individual's lifetime risk of developing cancer. This risk rises with cumulative dose; it is greater for children than adults and greater for females than males. As with all dental procedures, the small risk associated with the taking of a dental CBCT scan must be weighed against its potential benefits.

Dental CBCT scanners can provide excellent 3-dimensional diagnostic images of hard tissues with much lower radiation doses than conventional, medical multi-slice CT scanners of the same area. X ray dose for some tasks may be higher than conventional intraoral and panoramic techniques. Doses are dependent on equipment types and exposure settings, and the field of view selected.

As with all dental-imaging technology involving ionizing radiation, the principle of ALARA (As Low As Reasonably Achievable) should be foremost when considering the use of dental CBCT scanners. Dental CBCT scanners must be utilized in a responsible way that maximizes diagnostic value given the clinical context, but without exposing patients to unnecessary amounts of ionizing radiation. This requires the clinician to exercise professional judgment to achieve the appropriate balance between these two considerations.

The Standard is applicable to all dentists and dental specialists* in Nova Scotia who wish to operate a dental CBCT scanner for the purpose of imaging dental patients, as well as those who wish to prescribe dental CBCT scans for diagnostic purposes.

***Note: By virtue of their training, oral and maxillofacial radiologists and oral and maxillofacial surgeons licensed to practice in Nova Scotia are exempt from having to complete the additional training described in this standard.**

Dental CBCT Scanners

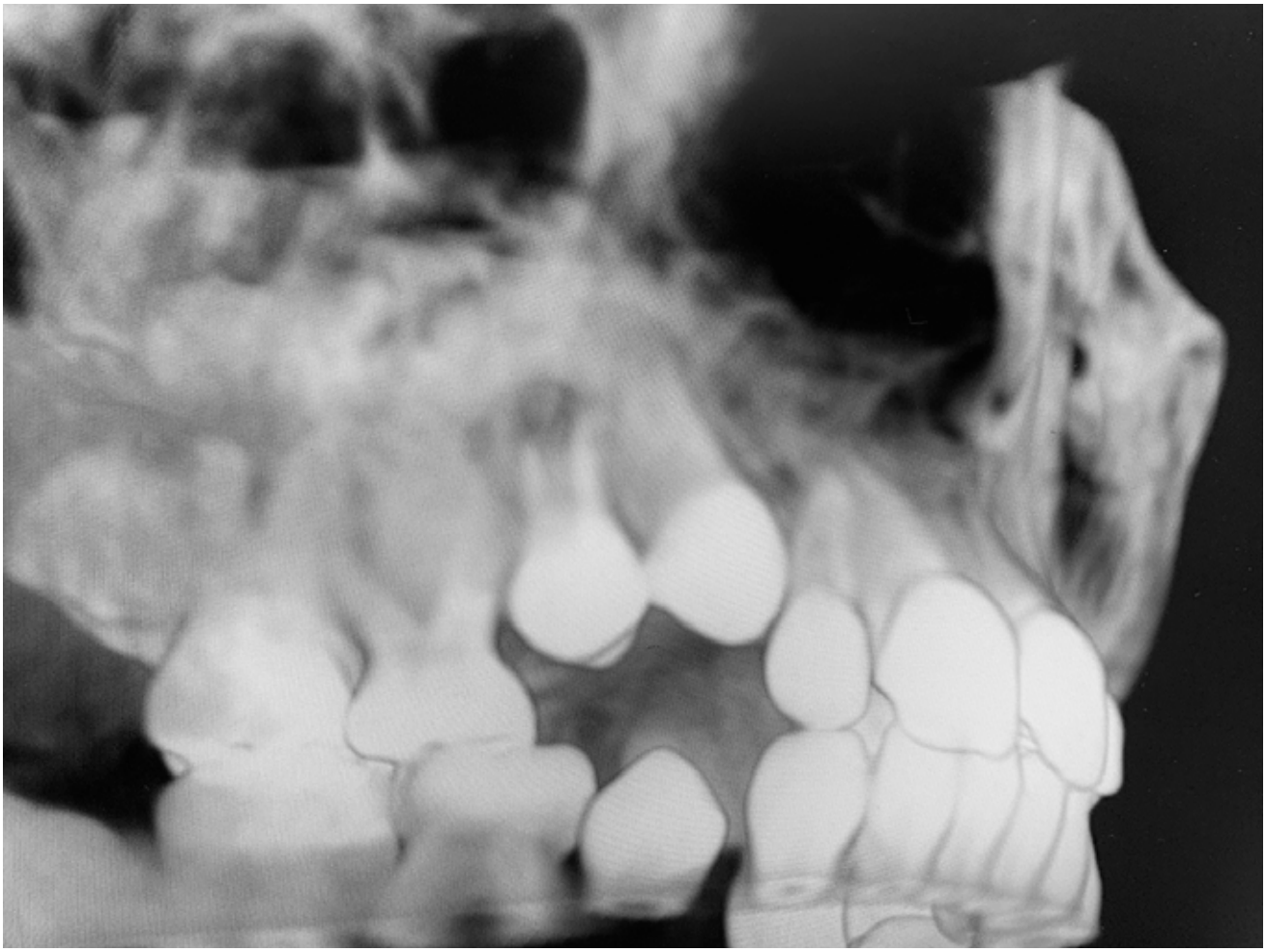
Field of View

Dental CBCT scanners may be classified by the spherical diameter or cylinder height of the image.

1. Dentoalveolar CBCT Scans — small field of view (9 cm or less)
   A small field of view is useful for imaging the teeth, their supporting structures, the mandible, and the maxilla up to the floor of the nose (dentoalveolar).

2. Craniofacial CBCT Scans — large field of view – over 9 cm
   In addition to dentoalveolar structures, a large field of view may include intracranial structures, the base of the skull, the temporomandibular joint, the paranasal sinuses, the cervical spine, the neck and the airway spaces (i.e., craniofacial). Some dental CT scanners offer a range of fields of view, while others are limited to a fixed field of view.

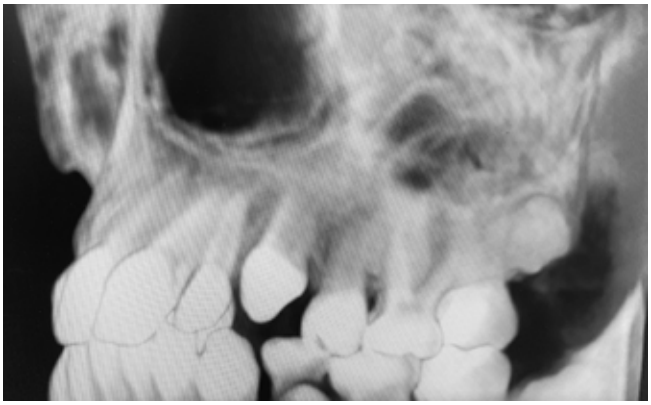
No matter the size, it is imperative that the entire field of view generated is examined and systematically reviewed for the presence of disease, regardless the specific reason for which it was ordered and taken.



Guiding Principles for Dental CT Scans

In addition to ALARA, the following guiding principles focus on strategies to manage and reduce the radiation dose related to dental CBCT scans.

1. A patient history and clinical examination must be completed prior to ordering and taking a dental CBCT scan. This must include an assessment of recent radiographs and/or other images that have been taken of the patient in the area of clinical interest.
2. The decision to order and take a dental CBCT scan must be justified. A dental CBCT scan should only be ordered and taken when the question for which imaging is require cannot be answered adequately by lower-dose conventional dental radiography or alternative imaging modalities.
3. Women of childbearing age must be screened for pregnancy. If the patient is pregnant or possibly pregnant, the benefits of performing a dental CBCT scan must be weighed against the possible risk to the fetus (Appendix l).
4. Each facility must develop a protocol for pediatric patients adjusted for size (Appendix ll).
5. The field of view must be limited to the area of clinical interest.
6. Each facility must develop a policy for patient shielding specifically for dental CBCT imaging (Appendix lII).
7. All dentists operating a dental CBCT scanner must be knowledgeable about the operational parameters of the unit and their influence on radiation dose and image quality.
8. A follow-up dental CBCT scan must be justified. If necessary, serious consideration should be given to modifying the field of view in order to reduce the radiation dose to the patient.



Professional Requirements

Educational Requirements

Qualifications for Auxiliaries Designated to Take Dentoalveolar or Craniofacial CBCT Scans

Training is to include both didactic and hands-on experience and include principles of radiation safety and protection, operating principles of CBCT equipment, exposure parameters and patient positioning.

Important: The required course needs to be taught to the level of understanding and knowledge of the auxiliary (i.e., a specific course for auxiliaries and not an adjunct to a dental (DDS) course.)

Qualifications for Dentists

The dentist requesting the scan is responsible for ordering, interpreting and reporting on any dental CBCT scan of a patient. This dentist must also have the requisite qualifications to do so. In addition, the dentist requesting the scan is responsible for ensuring that established policies and practices of the PDBNS are followed to ensure patient safety and the quality of diagnostic imaging.

The dentist requesting the scan must be currently registered in Nova Scotia and have successfully completed a theoretical and practical training program designed to produce competency in the ordering, taking, interpreting and reporting of dental CBCT scans with respect to the field of view generated.

DENTOALVEOLAR CBCT SCANS

For dentoalveolar CBCT scans of the teeth, their supporting structures, the mandible and the maxilla up to the floor of the nose (i.e., small field of view with a spherical diameter or cylinder height of 9 cm or less), the following training is required:

1. A course with a minimum of 15 hours of training using CBCT equipment given to dentists, general practitioners or specialists. The program should include theory and practical aspects covering:
    - radiation biology and physics
    - operating principles of CBCT equipment
    - indications, contra-indications and limitations for CBCT examinations
    - radiographic oral and maxillofacial pathosis
    - patient protection
    - patient positioning
    - the selection and influence of different parameters (kVp, mAs, FOV, resolution)
    - calibrating equipment
    - preparing and applying examination protocols
    - reconstructing images
    - saving and interpreting images
    - preparing a report

A certificate or other evidence of satisfactory completion of the course must be submitted to the PDBNS;

2. General dentists/specialists who have received theoretical and practical training in the areas of radiation physics and protection; indications and contraindications for dental CBCT scans; patient positioning; selection of parameters; development and implementation of protocols; and processing, interpreting and reporting of images as part of their dental/residency training. Documentation supporting the training must be submitted to the PDBNS for consideration.

CRANIOFACIAL CBCT SCANS

For craniofacial CT scans involving non-dentoalveolar structures (i.e., large field of view with a spherical diameter or cylinder height of over 9 cm), the following training is required:

1. Successful completion of a formal post-graduate program in oral and maxillofacial radiology **or** oral and maxillofacial surgery suitable for certification in the province of Nova Scotia. The program must have specifically evaluated and attested to the competency of the individual, **or**

2. Successful completion of a mentoring program with a certified oral and maxillofacial radiologist or certified medical radiologist involving the interpreting and reporting of at least 30 craniofacial CT scans. A letter or other evidence of satisfactory completion of the mentoring program and attesting to the competence of the candidate, as well as a description of the program signed by the mentor, must be submitted to the PDBNS for consideration.

Facility Requirements

Registration with the PDBNS

All dentists who wish to operate a dental CBCT scanner must register with the PDBNS and obtain a facility permit, which will be granted subject to the qualifications set out above and in conformance with all aspects of the Standard.

The facility permit holder bears the ultimate responsibility for:

- **a)** Developing and maintaining a procedure to ensure that only dental CBCT scans that are indicated and appropriate are provided (see Guiding Principles for Dental CBCT Scans).
- **b)** Developing, implementing and reviewing all dental CBCT imaging protocols for both adult and pediatric patients, including acquisition parameters, scanning region, patient positioning, and use of protective shielding.
- **c)** Ensuring that a dentist with the training outlined above is present in the facility whenever the dental CBCT scanner is being operated.
- **d)** Reviewing the qualifications, on-site training, and continuing education of all dentists and auxiliary staff ordering and taking dental CBCT scans; and
- **e)** Developing and maintaining a quality assurance program to ensure the accuracy and reliability of the facility's equipment (see Quality Assurance Program).

Installation

As with any x-ray machine, under section 3.1 of Health Canada's Safety Code 30, Radiation Protection in Dentistry — Recommended Safety Procedures for the Use of Dental X-Ray Equipment, the owner is responsible for the radiation safety of the facility and the equipment, including installation.

Initial Equipment Specifications and Acceptance Tests

The dental CBCT scanner must pass all acceptance tests at the time of installation as recommended by the manufacturer, including tests of x-ray tube output, voltage consistency and accuracy, filtration, exposure time and radiation field. Specific tests should, where applicable, include the following:

- **a)** CT pixel noise must be measured to verify that it meets the unit manufacturer's specifications
- **b)** Limiting spatial resolution must be measured to verify that it meets the unit manufacturer's specifications.
- **c)** Radiation beam width must be measured to verify that it meets the manufacturer's specifications.
- **d)** Slice sensitivity profile must be measured to verify that it meets the manufacturer's specifications.
- **e)** Accuracy of slice alignment indicators must be measured to verify that it meets the manufacturer's specifications.
- **f)** Verify no unusual artifacts.

In addition, testing of the correct operation of any automatic exposure control device, if fitted, is essential. All prescribing dentists ordering and taking dental CBCT scans must receive on-site training in the safe operation of the equipment at the time of installation.

Important: A dental CBCT scanner must receive a critical examination and pass detailed acceptance tests when installed, and routine quality assurance tests throughout the life of the equipment.

Quality Assurance Program

A quality assurance program according to manufacturers' specifications must be instituted to minimize the radiation risk to patients and staff, while ensuring consistently adequate diagnostic information is obtained from dental CBCT scans.

The quality assurance program should entail surveys and checks that are performed according to a regular timetable. A written log of this program must be maintained.

Quality control activities include, but are not limited to, the following:

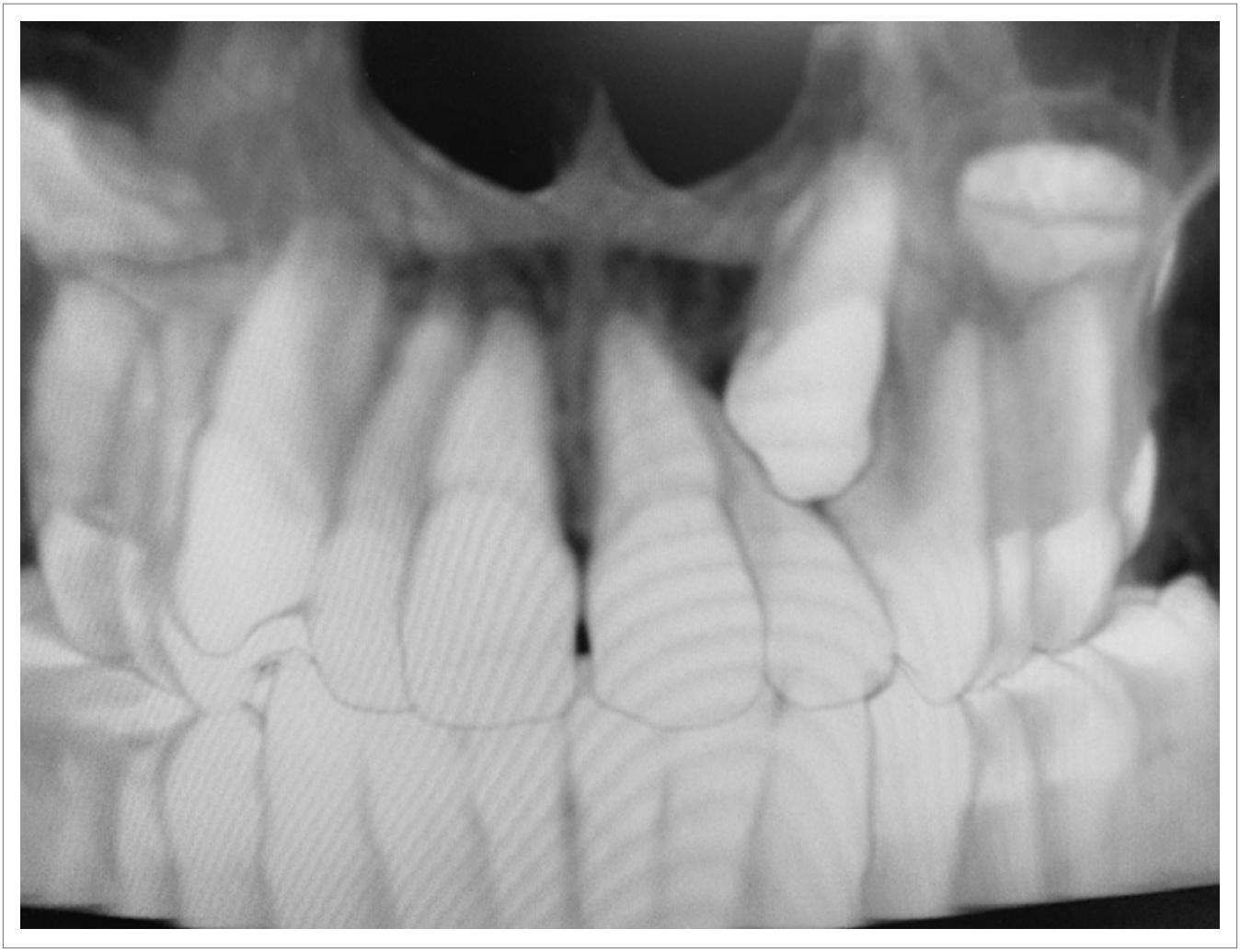
a) The facility has documented policies and procedures for monitoring and evaluating the effective management, safety and operation of dental CT equipment, as outlined by the provincial standard.

b) Dental CBCT scanners are properly maintained and calibrated as recommended by the manufacturer.

c) All safety measures follow federal and provincial laws/regulations. Specific tests include those conducted at the time of installation as recommended by the manufacturer.

d) Written records of preventative maintenance and equipment calibration are maintained.

e) A CT value phantom test is performed in accordance with equipment-supplier guidelines.



Clinical Requirements

A dentist may refer a patient to another dentist for a dental CBCT scan of a patient. However, the requesting dentist is responsible for reviewing and interpreting the entire CBCT volume which should be recorded in the patient's chart. As such the requesting dentist must also possess the educational requirements outlined above.

The dentist who is taking the CBCT images at the request of another dentist must also have the educational requirements outline above. However, they are not required to interpret the scan. They are responsible for reviewing the referral, creating a record/chart for the patient (as outlined below) and be present in the facility when the scan is being completed.

The decision to order and take a dental CBCT scan must be justified on an individual basis by demonstrating that the benefits to the patient outweigh the potential risks. The justification process for a pediatric patient is especially important because of the higher risks associated with the exposure of children to ionizing radiation. A dental CBCT scan should only be ordered and taken when the question for which imaging is required cannot be answered adequately by lower dose conventional dental radiography or alternative imaging modalities.

Important: Dental CBCT scans must not be ordered and taken routinely or for screening purposes.

Patient Referrals from Other Dentists

The patient referral should be accompanied by sufficient clinical information to allow the dentist taking the scan to perform the justification process. The following information should be provided by the referring dentist:

a) The patient's name, address and date of birth.

b) The referring dentist's name.

c) The type of dental CBCT scan requested for the patient, including any special instructions.

d) Pertinent clinical information, such as case history, provisional diagnosis and/or proposed treatment; **and**

e) Copies or a written report of any recent radiographs and/or other images that have been taken of the patient in the area of clinical interest.

If a patient arrives without appropriate referral information, the dentist taking the scan must contact the referring dentist for clarification. The dentist taking the scan must complete his/her own patient history and clinical examination prior to taking a dental CBCT scan, as per guiding principles.

Interpretation of Dental CBCT Scans

It is imperative that the entire field of view generated is examined and systematically reviewed for the presence of disease, regardless of the specific reason for which it was ordered and taken. If there is any uncertainty regarding the interpretation of a dental CBCT scan, consultation with an oral and maxillofacial radiologist, medical radiologist, or an oral and maxillofacial surgeon must be obtained.

Reporting of Dental CBCT Scans

A written report of the interpretation must be prepared for each dental CBCT scan by the dentist requesting the scan, regardless of the field of view generated or the specific reason for which it was ordered and taken. A report should include the following information:

a) The patient's name, address, date of birth and sex.

b) The prescribing dentist's name.

c) The location the area imaged and the size of the volume.

d) The dates of the dental CBCT scan, dictation and transcription.

e) Any limitations or technical factors, such as patient movement or metallic artifacts.

f) The reasons for taking additional radiographs and/or images, if deemed necessary.

g) The finding, using precise anatomical and radiological terminology.

h) Any pertinent clinical issues raised in the request for the dental CBCT scan.

i) Comparative information with previous radiographs and/or other images; **and**

j) A "conclusion" section, unless the dental CT scan is being compared with other recent radiographs and/or other images and no changes have occurred during the interval, or the body of the report is brief.

The report should also contain:

- A precise diagnosis, whenever possible.
- A differential diagnosis, when appropriate.
- Recommendations, when appropriate.
- Follow-up and additional diagnostic radiological studies to clarify or confirm the conclusion.

The final report should be proofread and signed by the requesting dentist.

Retention of Records

The dental CBCT dataset must be retained in compliance with the PDBNS Recordkeeping Guidelines and should be exportable in a format compatible with the international Standards Organization (ISO) referenced Digital Imaging and Communications in Medicine (DICOM) Standard. Dental CBCT images should display the patient's name, date, mAs, kVp and slice thickness. A copy of the final interpretation report must also be retained.

Appendix I

Protocol for Imaging Pregnant Patients

Any dental CBCT scan that can be safely deferred without negative impact on patient health or treatment will be delayed until after the pregnancy. For a patient that requires an urgent scan where delay could negatively impact patient health and/or complicate required treatment, a dental CBCT scan will be done. A lead-drape-type apron will be employed for the patient.

Appendix II

Protocol for Pediatric Patients Adjusted for Size

Training should include the use of pediatric settings for the unit purchased, and users must ensure that settings that provide diagnostic images with the lowest possible radiation are paramount for imaging of pediatric patients. A protocol for imaging a pediatric patient should be developed by the office/facility owning the scanner. The following link provides the best practices document adopted by the American Academy of Pediatric Dentistry (AAPD) (https://www.aapd.org/globalassets/media/policies_guidelines/bp_radiographs.pdf).

Thyroid collars will be used for all maxillary scans. Thyroid collars will be selectively utilized for scans involving the mandible but will not be employed when scatter artifact or image obstruction may occur. Lead-drape-type aprons should be employed.

Appendix III

Policy for Patient Shielding, Specifically for Dental CBCT Imaging

a) The CBCT unit should be capable of reduced arc scanning.

b) Leaded glasses should be considered when taking dental CT scans.

c) Thyroid collars should be employed for all maxillary collimated scans taken on children.

d) Thyroid collars will selectively be employed for mandibular scans but will not be used when risk of scatter artifact may affect scan quality.

e) Lead-drape-type aprons (poncho style) should be used if image quality will not be affected.

Appendix IV

Additional Resources and References

Materials available on the Internet:

- American Academy of Oral and Maxillofacial Radiology executive opinion statement on performing and interpreting diagnostic cone beam computed tomography, October 2008.
- www.aaomr.org/resource/resmgr/Docs/AAOMRExecStatement.pdf (Subscription required for access.)
- Healing Arts Radiation Protection (HARP) Commission Report, June 2007.
- https://www.ontario.ca/laws/statute/90h02
- Independent Health Facilities, Clinical Practice Parameters and Facility Standards, Computed Tomography, 2nd edition. http://www.health.gov.on.ca/en/common/ministry/publications/reports/disc_ct_mri/ct_report.pdf
- European Commission. Radiation Protection No 172 Cone beam CT for dental and maxillofacial radiology (Evidence-based guidelines), 2012. http://www.sedentexct.eu/files/radiation_protection_172.pdf

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