

STANDARD OF PRACTICE

Approved by Council - April 18, 2011

Dental CT Scanners

This document is the standard of practice in relation to the use of dental computed tomography (CT) scanners with respect to dental services in Ontario. Since contravention of the Standard may be considered professional misconduct, dentists employing dental CT technology must be familiar with its content, be appropriately trained and regulate their practices accordingly.

The following are the **minimum** standards for the use of dental CT scanners in dentistry. For the purposes of this document, the Standard is divided into the following sections:

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Introduction

DENTAL CT SCANNERS

Dental computed tomography (CT) scanners are a significant addition to the imaging armamentarium available for the investigation of dental patients. Dental CT technology has rapidly improved over the past decade 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 CT scanners utilize ionizing radiation, which can increase an individual's lifetime risk of developing cancer. This risk rises with cumulative dose, is greater for children than adults, and is greater for females than males. As with all dental procedures, the small risk associated with the taking of a dental CT scan must be weighed against its potential benefits.

Dental CT scanners are capable of providing excellent 3-dimensional diagnostic images of hard tissues with lower radiation doses than medical multislice CT scanners of the same area. However, such doses are usually significantly higher compared to conventional dental radiographic techniques, including panoramic radiography. Doses are dependent on equipment type and exposure settings, especially 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 CT scanners. In other words, dental CT 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 judgement to achieve the appropriate balance between these two considerations.

The Standard is applicable to all Ontario dentists who wish to install and operate a dental CT scanner for the purpose of imaging dental patients, as well as those who wish to prescribe dental CT scans for diagnostic purposes. Because of the rapid advancements in this field, and the proliferation of dental CT equipment manufacturers and models, newer imaging technologies that use ionizing radiation will need to be assessed. It is also expected that education and training in this technology will become a greater part of the undergraduate and specialty programs in dentistry. Accordingly, the Standard should be periodically reviewed by the Royal College of Dental Surgeons of Ontario (RCDSO) to keep pace with these developments.

Field of View

Dental CT scanners may be classified by the spherical diameter or cylinder height of the image or "field of view" generated.

- Small field of view – 8 centimetres 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 (i.e. dentoalveolar CT scan).

- Large field of view – over 8 centimetres

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 CT scan).

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 of 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 CT scans:

1. A patient history and clinical examination must be completed prior to ordering and taking a dental CT 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 CT scan must be justified. A dental CT 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.
3. Women of childbearing age must be screened for pregnancy. If the patient is pregnant or possibly pregnant, the benefits of performing a dental CT scan must be weighed against the possible risk to the fetus.
4. Each facility must develop a protocol for pediatric patients adjusted for size.
5. The field of view must be collimated to the area of clinical interest.
6. Each facility must develop a policy for patient shielding specifically for dental CT imaging.
7. All dentists operating a dental CT scanner at each facility shall be knowledgeable about the operational parameters of the unit and their influence on radiation dose and image quality.
8. A follow-up dental CT 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 of Dentists

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

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

1. Dentoalveolar CT scans

For dentoalveolar CT 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 8 centimetres or less), the following training is required:

- Successful completion of a course of instruction of at least two days duration with examination that must be affiliated with an accredited university, and organized and taught by dentists certified in oral and maxillofacial radiology. The curriculum must include theoretical and practical components, addressing radiation physics and protection, indications and contraindications for dental CT scans, patient positioning, selection of parameters, development and implementation of protocols, and processing, interpreting and reporting of images. A certificate or other evidence of satisfactory completion of the course, as well as a description of the program, signed by the course director must be submitted to RCDSO for consideration.

2. Craniofacial CT scans

For craniofacial CT scans involving non-dentoalveolar structures, including intracranial structures, the base of the skull, the temporomandibular joint, the paranasal sinuses, the cervical spine, the neck and/or the airway spaces (i.e. large field of view with a spherical diameter or cylinder height of over 8 centimetres), the following training is required:

- a) Successful completion of a formal post-graduate program in oral and maxillofacial radiology, suitable for certification in the province of Ontario. The program must have specifically evaluated and attested to the competency of the individual; **OR**
- b) • Successful completion of a formal post-graduate program in oral and maxillofacial surgery, suitable for certification in the province of Ontario. The program must have specifically evaluated and attested to the competency of the individual; **AND**
 - 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 50 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 RCDSO for consideration.

On-Site Training and Continuing Education

In addition to the above specified training, all prescribing dentists ordering and taking dental CT scans must receive on-site training in the safe operation of the equipment at the time of installation.

As well, prescribing dentists are expected to include courses and/or other educational programs related to the ordering, taking, interpreting and reporting of dental CT scans in their personal continuing dental education planning.

FACILITY REQUIREMENTS

Registration with RCDSO

All dentists who wish to install and operate a dental CT scanner in their facility must register with RCDSO and obtain a facility permit, which will be granted subject to the qualifications set out above and conformance with all aspects of the Standard. Furthermore, all dentists who wish to prescribe dental CT scans in the facility must register with RCDSO.

The facility permit will clearly designate the type of dental CT scanner that has been approved for use in that particular facility, as follows:

- DA-SCANNER Permit – dentoalveolar CT scanner with a field of view of 8 centimetres or less; **OR**
- CF- SCANNER Permit – craniofacial CT scanner with a field of view of over 8 centimetres.

The facility permit holder must be designated as the Radiation Protection Officer for the dental CT scanner. The facility permit holder bears the ultimate responsibility for:

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

Installation

1. Approval by Director of X-Ray Safety

As with any x-ray machine, under section 3 of the Healing Arts Radiation Protection Act (HARP Act) R.S.O. 1990, c.H.2, the written approval of the Director of X-ray Safety is required for a dental CT scanner to be installed. Furthermore, under section 23 of the HARP Act, the Minister of Health and Long-Term Care or his or her delegate must designate the facility for the installation and operation of any dental CT scanner.

IMPORTANT:

The facility permit will clearly designate the type of dental CT scanner that has been approved for use in that particular facility. Therefore, it is important to obtain a facility permit prior to seeking the approval by the Director of X-Ray Safety.

2. Initial equipment specifications and acceptance tests

The dental CT scanner must be new when installed in the facility. Further, it should have been manufactured within 12 months of installation and employ current technology.

The dental CT 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:

- CTDI (computed tomography dose index) must be measured to verify that it meets the unit manufacturer's specifications.
- CT number accuracy must be measured to verify that it meets the unit manufacturer's specifications in all protocols used.
- CT pixel noise must be measured to verify that it meets the unit manufacturer's specifications.
- Limiting spatial resolution must be measured to verify that it meets the unit manufacturer's specifications.
- Radiation beam width must be measured to verify that it meets the manufacturer's specifications.
- Slice sensitivity profile must be measured to verify that it meets the manufacturer's specifications.
- Accuracy of slice alignment indicators must be measured to verify that it meets the manufacturer's specifications.
- Verify no unusual artefacts.

In addition, testing of the correct operation of any automatic exposure control device, if fitted, is essential.

All prescribing dentists ordering and taking dental CT scans must receive on-site training in the safe operation of the equipment at the time of installation.

IMPORTANT:

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

Quality Assurance Program

A quality assurance program must be instituted to minimize the radiation risk to patients and staff, while ensuring consistently adequate diagnostic information is obtained from dental CT 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:

- 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.
- Dental CT scanners are properly maintained and calibrated as recommended by the manufacturer.
- All safety measures are in compliance with federal and provincial laws/regulations. Specific tests include those conducted at the time of installation as recommended by the manufacturer.

- Written records of preventative maintenance and equipment calibration are maintained.
- A CT value phantom test is performed in accordance with equipment supplier guidelines.

CLINICAL REQUIREMENTS

A referring dentist may request a dental CT scan of a patient. However, the prescribing dentist is responsible for ordering, taking, interpreting and reporting on any dental CT scan of a patient.

The decision to order and take a dental CT 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 CT 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 CT scans must not be ordered and taken routinely or for screening purposes.

Patient Referrals

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

- the patient's name, address and date of birth;
- the referring dentist's name, as well as the names of any other dentists who are to receive copies of the report;
- the type of dental CT scan requested for the patient, including any special instructions;

- pertinent clinical information, such as case history, provisional diagnosis and/or proposed treatment;
- 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 prescribing dentist must contact the referring dentist for clarification.

The prescribing dentist must complete his/her own patient history and clinical examination prior to ordering and taking a dental CT scan, as per guiding principles.

Interpretation of Dental CT 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 CT scan, consultation with an oral and maxillofacial radiologist or medical radiologist must be obtained.

Reporting of Dental CT Scans

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

- the patient's name, address and date of birth;
- the prescribing dentist's name;
- the type of dental CT scan performed;
- the dates of the dental CT scan, dictation and transcription;
- any limitations or technical factors, such as patient movement or metallic artefacts;
- the reasons for taking additional radiographs and/or images, if deemed necessary;
- the findings, using precise anatomical and radiological terminology;

- any pertinent clinical issues raised in the request for the dental CT scan;
- comparative information with previous radiographs and/or other images;
- 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.

Unusual, unexpected or urgent findings that may require immediate case management decisions shall be communicated to the referring dentist by the prescribing dentist.

Direct or attempted direct communication with the referring dentist must be documented.

Any discrepancy between a preliminary report and the final written report shall be directly communicated to the referring dentist or her/his representative.

RETENTION OF RECORDS

The dental CT dataset must be retained in compliance with the regulations and should be exportable in a format compatible with the International Standards Organization (ISO) referenced Digital Imaging and Communications in Medicine (DICOM) Standard. Dental CT 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

ADDITIONAL RESOURCES AND REFERENCE 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

American Academy of Oral and Maxillofacial Radiology
www.aaomr.org/resource/resmgr/Docs/AAOMRExecStatement.pdf

Healing Arts Radiation Protection (HARP) Commission Report, June 2007

Ontario Ministry of Health and Long-Term Care
www.health.gov.on.ca/english/public/pub/ministry_reports/harp/harp_report.pdf

Independent Health Facilities, Clinical Practice Parameters and Facility Standards, Computed Tomography, 2nd Edition 2009

College of Physicians and Surgeons of Ontario
www.cpso.on.ca/uploadedFiles/policies/guidelines/facilities/Computed%20Tomography.pdf

Radiation Protection: Cone Beam CT for Dental and Maxillofacial Radiology, Provisional Guidelines 2009 (v1.1 May 2009)

European Academy of DentoMaxilloFacial Radiology
www.sedentext.eu/system/files/sedentext_project_provisional_guidelines.pdf

Report of the Diagnostic Imaging Safety Committee for Computed Tomography (CT), February 2007

Ontario Ministry of Health and Long-Term Care
www.health.gov.on.ca/english/public/pub/ministry_reports/disc_ct_mri/ct_report.pdf