

## Guidance - Cone Beam Computed Tomography (CBCT)

### 1. Guidelines

The appropriate use of Cone Beam Computed Tomography (CBCT) in dental and maxillofacial radiology has the potential for improving patient treatment outcomes. Dental Council has generally adopted the core recommendations and statements of the European Commission document: Radiation Protection No 172, Cone Beam CT for Dental and Maxillofacial Radiology, Evidence Based Guidelines, (2012). Safety and quality care are the overarching standards for this guide. ALARA is a primary patient safety principle and is fundamental to all radiation usage and protection, especially CBCT. Competence underpins both standards.

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 on a patient without a new risk/benefit assessment having been performed.
5	When referring a patient for a 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. Referring dentists should be aware of referring criteria.
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. A copy of the clinical evaluation, including the selection criteria used and the patient dose factors, must be provided to the referring dentist.
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 a lower 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 must 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 must undergo regular routine tests to ensure that radiation protection, for both practice/facility users and patients, has not significantly deteriorated.
15	For staff protection from CBCT equipment, the guidelines detailed in Section 6 of the European Commission document ' <i>Radiation Protection 136. European Guidelines on Radiation Protection in Dental Radiology</i> ' 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 must 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 must 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 (' <i>radiological report</i> ') must be made by a specially trained DMF Radiologist or an adequately trained 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, clinical evaluation (' <i>radiological report</i> ') must be made by a specially trained DMF Radiologist or by a Clinical Radiologist (Medical Radiologist).

**Definitions**

ALARA	As Low [an exposure to ionising radiation] As [is] Reasonably Achievable
CBCT	Cone Beam Computed Tomography
DMF(R)	Dental and Maxillofacial (Radiology)
Medical CT	Medical Computed Tomography
MR(I)	Magnetic Resonance (Imaging)
TMJ	Temporomandibular Joint

## 2. Training Requirements

All training for the use of Cone Beam Computed Tomography (CBCT) equipment in Ireland should be cognisant of all current legislation, guidelines and accepted “best practice”. As defined in European Directive (Council Directive 2013/59/Euratom, 2013), the roles involved in the delivery of ionising radiation as a diagnostic tool in dentistry can be defined as:

**The Holder:** The person with legal responsibility under the legislation, for a radiological facility.

**The Referrer (Prescriber):** An individual, who under current legislation is entitled to prescribe/refer patients for a radiological investigation to a practitioner, and will be involved in the justification for that exposure.

**The Practitioner:** An individual, who under current legislation, is entitled to take clinical responsibility for part or all of the radiographic exposure of a patient.

Training requirements can be divided into two sections, as outlined in “Cone Beam CT for Dental and Maxillofacial Radiology. Evidence based guidelines. RP 172, European Union”. The first addresses the knowledge needed by the Prescriber and secondly that needed by the Practitioner.

### The Holder

The Holder in dental practice is commonly also a practitioner and a prescriber. As the person with a legal responsibility for the radiological installation they should also receive training that covers their responsibilities in that role. This can include:

- The relevant legislation that applies to the role of Holder
- Radiation physics relative to CBCT equipment
- Radiation doses and risks associated with the use of CBCT equipment
- Radiation protection measures relevant to CBCT equipment
- Clinical Audit

### The Referrer (Prescriber)

Theoretical Instruction

- The relevant legislation that applies to the role of a prescriber.
- The use of guideline documents to assist with selection criteria
- Radiation physics relative to CBCT equipment
- Radiation doses and risks associated with the use of CBCT equipment
- Radiation protection measures relevant to CBCT equipment
- Justification and optimisation of exposures
- The use of CBCT equipment

Radiological Interpretation

- The principles and practice of interpreting CBCT images in relation to dento-alveolar structures
- Normal radiographic anatomy on CBCT images
- Radiological interpretation and diagnosis of diseases relating to teeth and jaws on CBCT images
- Interpretation of artefactual images on CBCT images.

## **The Practitioner**

### Theoretical Instruction

- The relevant legislation that applies to the role of a practitioner
- The use of guideline documents to assist with selection criteria
- Radiation physics relative to CBCT equipment
- Radiation doses and risks associated with the use of CBCT equipment
- Radiation protection measures relevant to CBCT equipment
- Justification and optimisation of exposures
- The use of CBCT equipment
- CBCT image acquisition and processing

### Practical Instruction

- Principles of CBCT imaging
- The use of CBCT equipment
- Imaging techniques relevant to CBCT
- Quality assurance for CBCT images and CBCT equipment
- Patient care and management whilst undergoing CBCT examination
- Consent

### Radiological Interpretation

- The principles and practice of interpreting CBCT images in relation to dento-alveolar structures
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(Above taken and adapted from “Cone Beam CT for Dental and Maxillofacial Radiology. Evidence based guidelines”. RP172)

<b>Summary</b>	<b>Holder</b>	<b>Referrer</b>	<b>Practitioner</b>
Relevant legislation for that role	✓	✓	✓
Use of guideline documents to assist with selection criteria		✓	✓
Radiation physics of CBCT equipment	✓	✓	✓
Doses and risks from CBCT exposures	✓	✓	✓
Radiation protection relevant to CBCT equipment	✓	✓	✓
Justification and optimisation		✓	✓
Use of CBCT equipment	✓	✓	✓
Principles of interpreting CBCT images		✓	✓
Normal anatomy on CBCT images		✓	✓
Interpretation of diseases on CBCT images		✓	✓
Identifying artefacts on CBCT images		✓	✓
CBCT image acquisition and processing			✓
CBCT equipment			✓
Imaging techniques in CBCT			✓
Quality assurance in CBCT			✓
Patient care and management whilst undergoing a CBCT			✓
Consent			✓
Clinical Audit	✓		

### 3. Glossary of Terms

**CBCT (Cone Beam Computed Tomography):** It is a medical imaging technique that uses computer processed x-rays to produce cross-sectional images, or “volumes”, of specific areas of the body. Through the use of cone-shaped x-ray beams the radiation dosage and time needed for scanning can be greatly reduced compared to the conventional computed tomography (CT) imaging.

**Conventional (Traditional) Radiography:** Radiographic techniques and equipment that produce two dimensional images. Within dental radiography intra-oral peri-apicals, bitewings, occlusal views, panoramic tomography, oblique views of the mandible could all be considered as conventional radiographic techniques.

**Craniofacial:** Associated with the head and face. In terms of dental CBCT, this generally implies a field greater than 10cm, allowing the base of the skull, zygomatic bones and the orbits to be viewed.

**Critical Examination and Acceptance tests:** The process, normally carried out by a Radiation Protection Advisor to test the parameters of a piece of equipment to ensure it can be licensed and used within the jurisdiction.

**Dento-alveolar:** The teeth and that part of the jaw that supports the teeth.

**DMF(R) (Dental and Maxillofacial (Radiology)):** A branch of radiology which is concerned with use of imaging techniques in the examination, diagnosis and treatment of disease related to teeth and other regions of the face, jaws and related structures, and the subsequent interpretation of these images

**DMF Radiologist:** A clinician with additional training in the field of Dental and Maxillofacial radiology. Where a specialist list exists, the clinician should be registered on this list.

**Light beam markers:** Visual aids provided on radiographic equipment to allow correct positioning of the patient.

**Mandible:** The lower jawbone.

**Maxilla:** The upper jaw. It assists in the formation of the orbit, the nasal cavity, and the hard palate.

**Medical CT (Medical Computed Tomography):** It is a medical imaging technique that uses single or multiple receptors in conjunction with a rotating radiation source to produce three-dimensional images of an area of a patient.

**MR(I) (Magnetic Resonance (Imaging)):** An imaging technique based on computer analysis of high frequency radio waves in tissues placed in a strong magnetic field. This magnetic field is generated in the scanner in which a patient is placed. Unlike CT scans or traditional x-rays, MRI does not use ionizing radiation.

**Quality Assurance Programme:** Planned and systematic actions to provide the assurance that the equipment, image quality and radiation protection measures are at the required standard. This programme should include a process of clinical audit to monitor improvements and identify areas that require improvement.

**Radiological report:** A report, which should be written, following the use of radiographic equipment to produce images with the purpose of aiding examination, diagnosis and treatment planning for a patient.

**Referral criteria:** Referral (selection) criteria are clinical guidelines to help in the process of justification of an X-ray examination. Where a practitioner accepts referrals for imaging using CBCT, that practitioner should advise the referrer (prescriber) of referral (selection) criteria used. The use of referral (selection) criteria is in both the Referrer and Practitioner training requirements.

**Temporomandibular Joint:** The joint (articulation) between the temporal bone of the skull and the lower jaw (mandible).

**References:**

1. European Commission Radiation Protection No 172: Cone Beam CT for Dental and Maxillofacial Radiology Evidence-Based Guidelines 2012.
2. European Council Directive 2013/59/Euratom of 5<sup>th</sup> December 2013 laying down basic safety standards for protection against dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 97/43/Euratom and 2003/122/Euratom