SUMMARY OF IAEA SAFETY REPORT NO. 108

'RADIATION PROTECTION IN DENTAL RADIOLOGY'

AARHUS UNIVERSITY
AARHUS INSTITUTE OF ADVANCED STUDIES

IAEA-IADMFR WEBINAR
28 OCTOBER 2022

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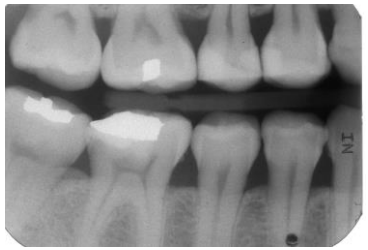
SAFETY REPORT & TRAINING MATERIAL

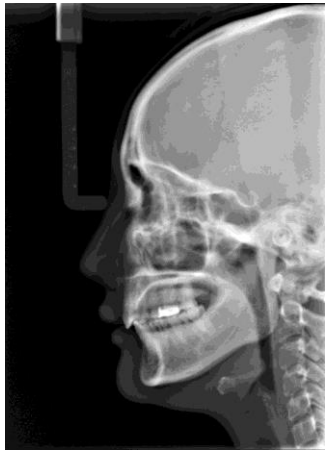
1. Introduction (p. 1-3)
2. Imaging modalities and techniques used in dental radiology (p. 3-13)
3. Framework for radiation protection in dental radiology (p. 13-31)
4. Justification and imaging guidelines (p. 31-42 + Annex)
5. Optimization of radiation protection [...] (p. 42-69)
6. Occupational and public protection (p. 69-76)

- 01. General Principles of Radiation Protection
- 02. Special Considerations for Radiation Protection in Children
- 03. X-ray Production and Interaction: Image Formation and Image Quality
- 04. General Principles of Film and Digital Radiography
- 05. Fundamentals of Intraoral Radiography
- 06. Fundamentals of Panoramic Radiograhy
- 07. Fundamentals of Extraoral Projectional Radiography
- 08. Fundamentals of CT and CBCT
- 09. Justification and Appropriate Use of Dental Radiology
- 10. Quality Assurance in Dental Radiology
- 11. Optimization of Protection of Patients in Dental Radiology
- 12. Protection of Workers and Public in Dental Radiology

2. IMAGING MODALITIES

- **Descriptive**
  - Intraoral Radiography
  - Panoramic Radiography
  - Cephalometric Radiography
  - Cone-beam computed tomography
  - (Multi-detector) computed tomography





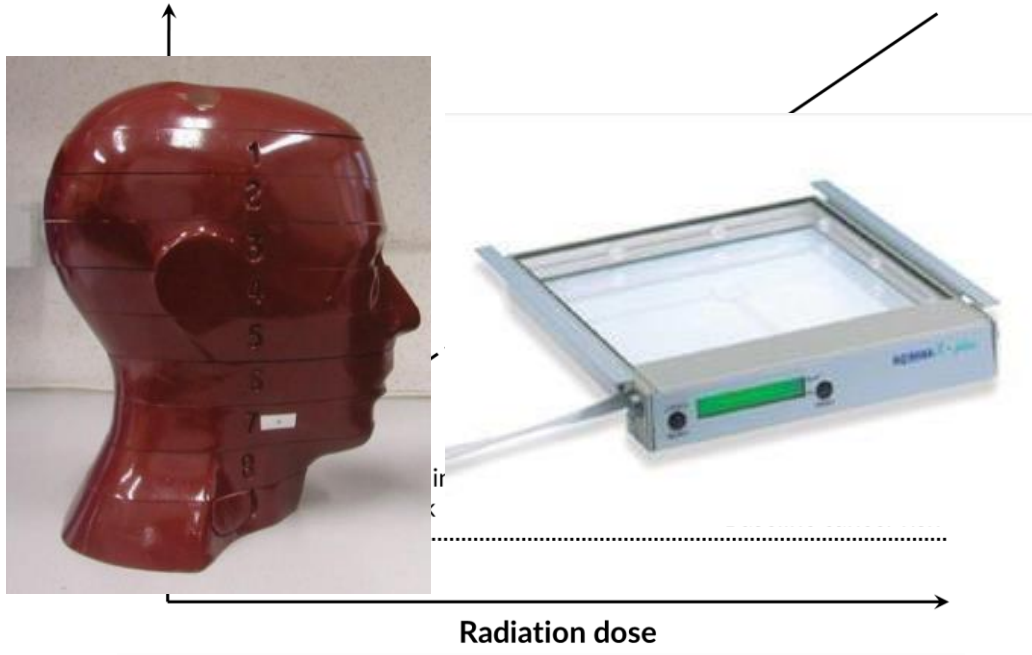
- Section on **CBCT** does contain some hints towards optimization:
  - Slice thickness/interval: small structures and pathosis may be hidden/obscured
  - Metal artefact reduction: validity of MAR TBD on a clinical level
- **CBCT vs MDCT** comparative table

CBCT VS. MDCT

TABLE 2. OVERVIEW OF DIFFERENCES BETWEEN CURRENT GENERATION CBCT AND MDCT SYSTEMS

	CBCT	MDCT
X ray tube	Single X ray source, with a single beam energy being used almost exclusively	Dual energy/dual source and spectral CT currently in clinical use (but not commonly used for dental applications)
X ray beam	X ray beam collimated along every aspect to as small as a few centimetres in height or width	Wider X ray beam, which fully covers the head; only the scan length is variable
Detector	Flat panel detector with small detector elements (pixels), but limited detector sensitivity and speed No detector side collimation, resulting in large amounts of scatter	High speed detectors and detector elements are larger Scatter reduction along longitudinal axis possible through the use of collimation between adjacent rows of detectors
Exposure	Automatic exposure control not commonly used Relatively long scan time (typically 10–20 s) Typically, low tube current settings (≤10 mA)	Tube current modulation, both angular and longitudinal, is almost ubiquitous Subsecond scans possible for modern equipment

3. FRAMEWORK FOR RP



- Radiation risk (descriptive)
- Radiation dose (quantities)
- Basic principles of RP
- Roles and responsibilities
- Education and training
  - **3.5.6 Considerations for dental radiology (& Appendix II)**
- Quality assurance and quality audit

4. JUSTIFICATION

- General approaches
- Justification in **2D dental radiography**
- Justification in **3D dental imaging**
- Justification in **paediatric** patients
- Justification in **pregnant** patients
- Justification for **carers and comforters**
- Available **guidelines**
- **Annex:** non-exhaustive selection of **clinical indications** for dental radiological imaging, derived from existing professional guidelines.

4. JUSTIFICATION (ANNEX)

(a) None — techniques using no ionizing radiation;
(b) ☢ — effective dose typically <25 μSv;
(c) ☢☢ — effective dose typically <100 μSv;
(d) ☢☢☢ — effective dose typically <500 μSv.

TABLE A–1. NON EXHAUSTIVE LIST OF CLINICAL INDICATIONS (CLINICAL TASKS) FOR DENTAL IMAGING, ASSEMBLED FROM EXISTING PROFESSIONAL GUIDELINES [A–1 to A–13] (cont.)

Clinical task	Type of examination	Dose level	Suggestion	Comment
Implant therapy: planning	Intraoral periapical radiograph	☢	Indicated	Various combinations of imaging can be justified for implant planning, depending on clinical complexity and the surgeon's judgement. CBCT may offer lower dose than MDCT, although low dose protocols for MDCT may overcome this. CBCT usually has advantages for dose over MDCT when a small FOV can be used Magnetic resonance imaging for implant planning is currently limited to a few specialist centres.
	Panoramic radiograph	☢	Indicated	
	CBCT	☢ or ☢☢☢	Indicated	
	MDCT	☢ to ☢☢☢☢	Indicated	
	Magnetic resonance imaging	None	Specialized investigation	
Implant therapy: intra-operative	Intraoral periapical radiograph	☢	Indicated	May be needed during preparation of implant site

5. OPTIMIZATION

- Overview of optimization principles per modality
  - General considerations, intra-oral RX, panoramic RX: ~2 pp.
  - CBCT: ~4 pp.
    - FOV, exposure parameters, patient immobilization, Hounsfield units, metal artefact reduction, viewers
- Quality control
- Diagnostic reference levels

5. OPTIMIZATION (CONT.)

- Procedural aspects (per modality)
  - **Patient shielding**: mentioned in CBCT section (5.4.5)
    - Thyroid: collar can be used unless overlapping with ROI
    - Eye lens: collimation as primary reduction mechanism

- Pediatric and pregnant patients
- Carers, comforters, volunteers, accidents

6. OCCUPATIONAL/PUBLIC PROTECTION

- Reiterates prior IAEA documents, defers to national legislation (when applicable)

- 6.5.2. Dental facilities with intraoral and panoramic equipment
- 6.5.3. Dental facilities with cone beam computed tomography equipment

WAY FORWARD

- Still plenty of issues to address in dental RP
  - Teaching / radiobiology: see next speakers
  - Dynamic justification / optimization

- EFOMP Special Interest Group – Dental Imaging
  - Call for members: https://tinyurl.com/efomp-dental
  - Info/applications: pauwelsruben@hotmail.com