SUMMARY OF IAEA SAFETY REPORT NO. 108

‘RADIATION PROTECTION IN DENTAL RADIOLOGY’
SAFETY REPORT & TRAINING MATERIAL

1. Introduction (p. 1-3)
2. Imaging modalities and techniques used in dental radiology (p. 3-18)
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 Radiography
- 07. Fundamentals of Extraoral Projected 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>
<thead>
<tr>
<th></th>
<th>CBCT</th>
<th>MDCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>X ray tube</td>
<td>Single X ray source, with a single beam energy being used almost exclusively</td>
<td>Dual energy/dual source and spectral CT currently in clinical use (but not commonly used for dental applications)</td>
</tr>
<tr>
<td>X ray beam</td>
<td>X ray beam collimated along every aspect to as small as a few centimetres in height or width</td>
<td>Wider X ray beam, which fully covers the head; only the scan length is variable</td>
</tr>
<tr>
<td>Detector</td>
<td>Flat panel detector with small detector elements (pixels), but limited detector sensitivity and speed No detector side collimation, resulting in large amounts of scatter</td>
<td>High speed detectors and detector elements are larger Scatter reduction along longitudinal axis possible through the use of collimation between adjacent rows of detectors</td>
</tr>
<tr>
<td>Exposure</td>
<td>Automatic exposure control not commonly used Relatively long scan time (typically 10–20 s) Typically, low tube current settings (≤ 10 mA)</td>
<td>Tube current modulation, both angular and longitudinal, is almost ubiquitous Subsecond scans possible for modern equipment</td>
</tr>
</tbody>
</table>
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)

<table>
<thead>
<tr>
<th>Clinical task</th>
<th>Type of examination</th>
<th>Dose level</th>
<th>Suggestion</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implant therapy: planning</td>
<td>Intraoral periapical radiograph</td>
<td>📆</td>
<td>Indicated</td>
<td>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.</td>
</tr>
<tr>
<td>Panoramic radiograph</td>
<td>📆</td>
<td>Indicated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBCT</td>
<td>📆 or 📆</td>
<td>Indicated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MDCT</td>
<td>📆 to 📆</td>
<td>Indicated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnetic resonance imaging</td>
<td>None</td>
<td>Specialized investigation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implant therapy: intra-operative</td>
<td>Intraoral periapical radiograph</td>
<td>📆</td>
<td>Indicated</td>
<td>May be needed during preparation of implant site</td>
</tr>
</tbody>
</table>
5. OPTIMIZATION

- Overview of optimization principles per modality
  - General considerations, intra-oral RX, panoramic RX: ~2 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