Understanding IAC CT Accreditation

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LANDAUER Medical Physics

Disclosures

• Serve as one of two AAPM representatives to IAC CT Board of Directors,
• Serve as IAC representative to AAPM for focus group on accreditations
• Provide 3-hour online course on CT Radiation Safety, for users of CBCT

Outline

• Who is IAC and why do they accredit CT?
• IAC CT Standards and Guidelines
• Review of CBCT Principles
• Medical Physics Measurements for CBCT Systems – Medical and Dental
• IAC Accreditation Requirements and Process
• Summary and Conclusion

Learning Objectives

• Review the IAC CT Accreditation program and typical facilities seeking accreditation
• Review relevant Medical Physics processes and responsibilities unique to IAC CT Accreditation
• Review common problems with medical physics reports submitted to IAC CT Accreditation
• Review the process of applying for IAC CT Accreditation

Who is the IAC?

• Intersocietal Accreditation Commission
• 22 years of imaging accreditation experience
• Board of directors are specialists in various medical fields
• Over 12,000 accredited sites
• Recognized by CMS as an Accrediting Organization
• Earned ISO certification

IAC History

Improving health care through accreditation
## Benefits of Accreditation

- **Commitment to quality**
- **Recognition of your skills**
  - High quality services
  - Patients
- **Educational tool**
  - Continuous quality improvement

## Payment Policies

- **MIPPA Law 2008**
  - Nuclear, PET, MRI, CT
  - Accreditation required by 1/1/2012
  - 120 day CMS grace period
  - for adding new sites if currently accredited
  - Includes dentists that utilize CT scanners
  - Oral surgeon penalized by CMS for Medicare billing without accreditation
- **Private Insurers and State programs**
  - Some private insurers may require accreditation
  - California (CT), Minnesota (CT, Nuc/PET, MRI)
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CT Standards

• Dental staff training and experience requirements
• Patient and employee safety policies
• Equipment QC
• Radiation oversight and safety adherence
• Report content
• Quality improvement program

Physics Guidance

• Radiation Protection Survey
• Image Quality and Dose Assessment

1. Which of the following is *not* true about the IAC CT Accreditation program?

- a) Anyone with a BS degree or higher may perform CT annual medical physics surveys
- b) The initial radiation protection survey must include measurements and calculations of exposure to persons in the vicinity of the scanner
- c) Image quality evaluations must include slice thickness, uniformity, noise, and other parameters using a phantom chosen by the medical physicist
- d) Dosimetry must include measurements and comparison with appropriate benchmarks, chosen by the medical physicist
- e) The IAC CT Guidance document describes what is expected of the medical physicist

**Ref:** http://www.intersocietal.org/ct/main/standards.htm

GAO-13-246 5-31-13 Establishing Minimum National Standards and an Oversight Framework Would Help Ensure Quality and Safety of ADI services

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**Toshiba Aquilion 64 MDCT and NewTom vGi CBCT Scanner (Dental)**

A Comparison of Maxillofacial CBCT and Medical CT, Christos Angelopoulos
Basics of CBCT

• During the rotation, multiple sequential planar projection images covered by the detector or the field of view (FOV) are acquired in an arc of 180° or greater
• These single projection transmission images constitute the raw primary data and are individually referred to as basis, frame, or raw images
• Basis images appear similar to cephalometric radiographic images
• There are usually several hundred projection-basis images that are reconstructed into an image volume
• The complete series of images is referred to as the projection data or volumetric dataset

Advantages of CBCT

• Irradiated field of view (FOV) reduced to region of interest
  • Mechanical lead collimation or electronic masking
  • Only collimation reduces volume of tissue irradiated
• One new system now allows operators to select
  • 5 different FOV
  • 3 different dose levels
  • Variable SID (magnification)
• Designed specifically for needs of ENT/Dental facilities
  • High resolution
  • Contrast and Dose optimized for air/bone (not soft tissue)
  • Point of Care application
  • Ease of use by MD or Dentist (may be changing…)

MDCT vs. CBCT

<table>
<thead>
<tr>
<th></th>
<th>MDCT</th>
<th>CBCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-ray source</td>
<td>80-140 kVp</td>
<td>80 – 120 kVp</td>
</tr>
<tr>
<td></td>
<td>20-100 kW</td>
<td>Stationary Anode</td>
</tr>
<tr>
<td>Focal Spot</td>
<td>0.5 – 1.2 mm</td>
<td>0.5 – 1.2 mm</td>
</tr>
<tr>
<td>Detector</td>
<td>MD arrays</td>
<td>Flat panel</td>
</tr>
<tr>
<td></td>
<td>64 – 256+ rows</td>
<td>Ti:Csl, Tr:GdOS</td>
</tr>
<tr>
<td>Spatial Res</td>
<td>0.5 – 0.625 mm</td>
<td>0.4 mm (20 cm FOV)</td>
</tr>
<tr>
<td>Contrast Res</td>
<td>~1 HU</td>
<td>~10 HU</td>
</tr>
</tbody>
</table>

Conclusions: The Kodak 9000 3D provides doses that are substantially lower than previously reported doses produced by medium and large FOV CBCT units. The digital panoramic mode provides a low dose alternative for panoramic examinations of the jaws using the same unit.
Ludlow JB: Patient risk related to common dental radiographic examinations  JADA 2008

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**Equivalent dose** to tissues and organs in the head and neck resulting from common dental radiographic examinations.

<table>
<thead>
<tr>
<th>ORGAN</th>
<th>EDD</th>
<th>KAP</th>
<th>DAP</th>
<th>Risk</th>
<th>ADJ</th>
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</thead>
<tbody>
<tr>
<td>Brain</td>
<td>31.7</td>
<td>10.9</td>
<td>9.0</td>
<td>31.7</td>
<td>3.0</td>
</tr>
<tr>
<td>Eye</td>
<td>4.0</td>
<td>9.0</td>
<td>10.7</td>
<td>8.1</td>
<td>9.0</td>
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<tr>
<td>Oral</td>
<td>174.3</td>
<td>85.8</td>
<td>174.0</td>
<td>105.5</td>
<td>9.4</td>
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<td>Gland</td>
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<td>10.4</td>
<td>31.0</td>
<td>10.5</td>
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<tr>
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<td>9.0</td>
<td>10.4</td>
<td>31.0</td>
<td>10.5</td>
</tr>
<tr>
<td>Nose, Sinus</td>
<td>8.2</td>
<td>9.0</td>
<td>10.4</td>
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**Effective dose for commonly used dental radiographic examinations:** comparison of International Commission on Radiological Protection (ICRP) methods from 1990 and 2007.

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**Principles of CBCT – Dosimetry**

Dosimetric Evaluation in Dental Radiology: Radiological procedures performed for panoramic and volume acquisitions with the Kodak 9000 3D device, Report n°2008-07 RADIOLÓGICA PROTECCIÓN Y SALUD HUMANA (DRPH)
Medical Physics Responsibilities

- Reports follow Guidance Documents for
  - Radiation Protection Survey (one time)
  - Image Quality and Dose reports
- Phantom Images from Annual MP Survey
- Participate in Quarterly QC Committee Meetings
- 3 hour CT Radiation Safety Training (quiz=100%) for operators who are not RT’s

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CT Medical Physicist or Qualified Expert Report

Guidance Document

[CT Medical Physicist or Qualified Expert Report Guidance Document]

http://www.intersocietal.org/ct/forms/CT_Medical_Physicist_or_Qualified_Expert_Report.doc

[CT Medical Physicist or Qualified Expert Report Guidance Document]
Adapt CT measurement techniques

- Challenges
  - Image Quality phantom size
  - AAPM Head dosimetry OK
  - Use of detector entrance exposure?
  - Positioning phantoms – not trivial!
  - Multiple FOV, SID choices

- Challenges
  - Image Quality phantom size
  - AAPM Head dosimetry OK
  - Use of detector entrance exposure?
  - Positioning phantoms – not trivial!
  - Multiple FOV, SID choices
2. For dental CBCT systems, what are the minimum requirements for measurement of dose and image quality?

a) The methods described in the ACR CT accreditation program QC Manual (2012)

b) Only dose measurements performed using TLD’s in a Rando head phantom are acceptable

c) Physicist must adapt the standard CT testing methods to the unique challenges of CBCT systems

d) Dose measurements are not necessary because all new systems are self-calibrating


Correct for Geometry to Image Receptor

<table>
<thead>
<tr>
<th>Distances, from CI, IMTEC</th>
<th>inches</th>
<th>mm</th>
<th>Approx CTDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>F5 to detector</td>
<td>31</td>
<td>787.4</td>
<td>V: 40.5mm</td>
</tr>
<tr>
<td>F5 to tube cover (for CTDP)</td>
<td>6.347</td>
<td>161.2</td>
<td>H: 51mm</td>
</tr>
<tr>
<td>F5 to axis of rotation</td>
<td>24</td>
<td>609.6</td>
<td>V2: 29mm</td>
</tr>
<tr>
<td>Patient (axis of rotation) to detector</td>
<td>7</td>
<td>177.8</td>
<td></td>
</tr>
<tr>
<td>F5 to detector active depth</td>
<td>31.607</td>
<td>802.8</td>
<td></td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>CTDP at tube half length</th>
<th>Exposed length of pencil chamber (assuming point source)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Field</td>
<td>40.5</td>
</tr>
<tr>
<td>Reduced Field</td>
<td>29</td>
</tr>
<tr>
<td>Horizontal</td>
<td>51</td>
</tr>
</tbody>
</table>
Regarding assessment of beam collimation in CBCT systems:

a) Scanning of GafChromic media images may be used, corrected for geometry  
b) CR or film based imaging systems must be used to detect the x-ray beam  
c) This is not necessary because CBCT systems collimate automatically  
d) Is not possible to be performed in the field by a medical physicist

3. What is the accepted way to assess beam collimation in CBCT systems:

20% a) Scanning of GafChromic media images may be used, corrected for geometry  
20% b) CR or film based imaging systems must be used to detect the x-ray beam  
20% c) This is not necessary because CBCT systems collimate automatically  
20% d) Is not possible to be performed in the field by a medical physicist


Morita 3D Accuitomo 170

Special thanks to Aditya Tadinada, BDS, UConn

Reduced Dosage

Dosage has been reduced 30% to 40% compared to the previous Accuitomo model.

Four Imaging Modes

A mode to serve every purpose: High Resolution Mode and High Fidelity Mode can be used for the highest quality of images. High Speed Mode reduces motion artifacts. Standard Mode can be used for both limited and broad fields of view.

Nine Field of View (FOV) Sizes

A wide FOV range, from 40 x 40 mm up to 170 x 120 mm, captures a couple teeth up to the entire head and neck area.

Five Resolution Levels

Select the voxel size that best suits your diagnostic needs: 80 μm, 125 μm, 160 μm, 200 μm, or 250 μm.
3D Accuitomo 170 offers nine FOV:
- 40 x 40 mm to 170 x 120 mm
Enables examination of temporal bone, paranasal sinuses, mandible, and skull base.

**FOV:**
- Ø 40 x H 40 mm
- Ø 60 x H 60 mm
- Ø 80 x H 80 mm
- Ø 100 x H 100 mm
- Ø 100 x H 50 mm
- Ø 140 x H 50 mm
- Ø 140 x H 100 mm
- Ø 170 x H 50 mm
- Ø 170 x H 120 mm

**FEATURES**
- Super high resolution, 80 µm voxel, CsI FPD
- Very low effective dose: 170 x 120 mm (entire head/neck area) is 25% less dosage than an FMX, F-speed film*
- 14 bit grayscale
- Zoom reconstruction feature – no need to re-take images
- Flat panel detector
- Scan time - 18 sec. or less 360° scan; 9 sec. or less 180° scan
- One Data Viewer – 3D images can be viewed on any computer without special software
- Volume rendering function
- Intra-clinic network compatibility
- Compact: 63-3/4" x 47-1/4"
- 9 FOV from Ø 40 x H 40 mm to Ø 170 x H 120 mm

**Images and Clinical cases**
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The Medical Physicist should clearly identify for each facility:

- Equipment Quality Control
  - Quality Control Acceptance Test Results (QC test results) performed after installation or after major upgrade or room (suite)
  - 5 days of CT tests (with test results and corresponding phantom images)
  - Annual Preventive Maintenance Report
  - Radiation Shielding Verification Survey (post-installation)
  - Physician Annual Survey (to include image quality, phantom images, and patient dose assessment)

Mid-cycle Audits

- 100% of facilities will get a random audit or site visit
- Date is randomly selected - may happen at any time during the course of the facility's accreditation – may be in the form of an unannounced site visit
- No additional cost to the facility for the site visit
- Failure to submit audit documents or agree to the site visit may result in suspension or loss of accreditation

4. For IAC CT accreditation, facilities must submit:

- 20% a) Dosimetry provided by the manufacturer
- 20% b) TLD's mounted to the surface of the ACR accreditation phantom
- 20% c) Images of the ACR CT accreditation phantom, reconstructed at the minimum slice thickness
- 20% d) Reports and image quality assessments performed by a medical physicist or other individual state approved to perform these measurements in CT facilities
- 10% e) The standard ACR dosimetry report for an adult abdomen

Summary

- IAC accredits about ¼ of all CT scanners that are accredited
- IAC CT Standards and Guidelines
- Medical Physics Measurements for CBCT Systems – Medical and Dental
- IAC Accreditation Requirements and Process

Conclusion

- The medical physicist can make a significant contribution to dental imaging facilities through careful measurements, education and consultation