Performance-based QA for Radiotherapy: TG 135 QA for Robotic Radiosurgery

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Status of TG 135

- Writing cut-off for final editing in Oct 2008
- Original Draft submitted to AAPM Quality Assurance Subcommittee (QASC) for ASTRO 2008
- Revised Draft submitted to QASC in early July
- At the time of submitting this slide: …
- Review by TPC, comments from Professional Council
- Submission to Medical Physics

Table of Contents

Table of Contents continued:

TG-135 does not contain:

- Instructions for commissioning
- Recommendations on specific detectors
- Recommendations on technology implemented widely in clinics after October 2008

TG-135 is:

- A fast-track TG giving basic recommendations until switching to TG-100 style QA
- Pointing out areas where we need to develop QA

QA for Individual System Components: Accelerator

- Obvious differences to regular linac:
  - No flattening filter
  - Fixed & IRIS collimators
  - X-band
  - No bending magnet
- QA is straightforward, follow TG-40, TG-42 and TG-45
- Small field dosimetry (to be found in TG-155):
  - Practical Aspects of CK Small Field Dosimetry, WE-213A-2, 4pm, Room 213A

QA for Individual System Components: Software

- TG-53 gives excellent guidelines
- CK software is integral part of system
- Topics not covered by TG-53:
  - Data security: who can change data, and how?
  - Custom CT density model
  - Checking accuracy of inhomogeneity calculations
    - With ray-tracing algorithm
    - With MC
- Patient or patient-like QA (more later)

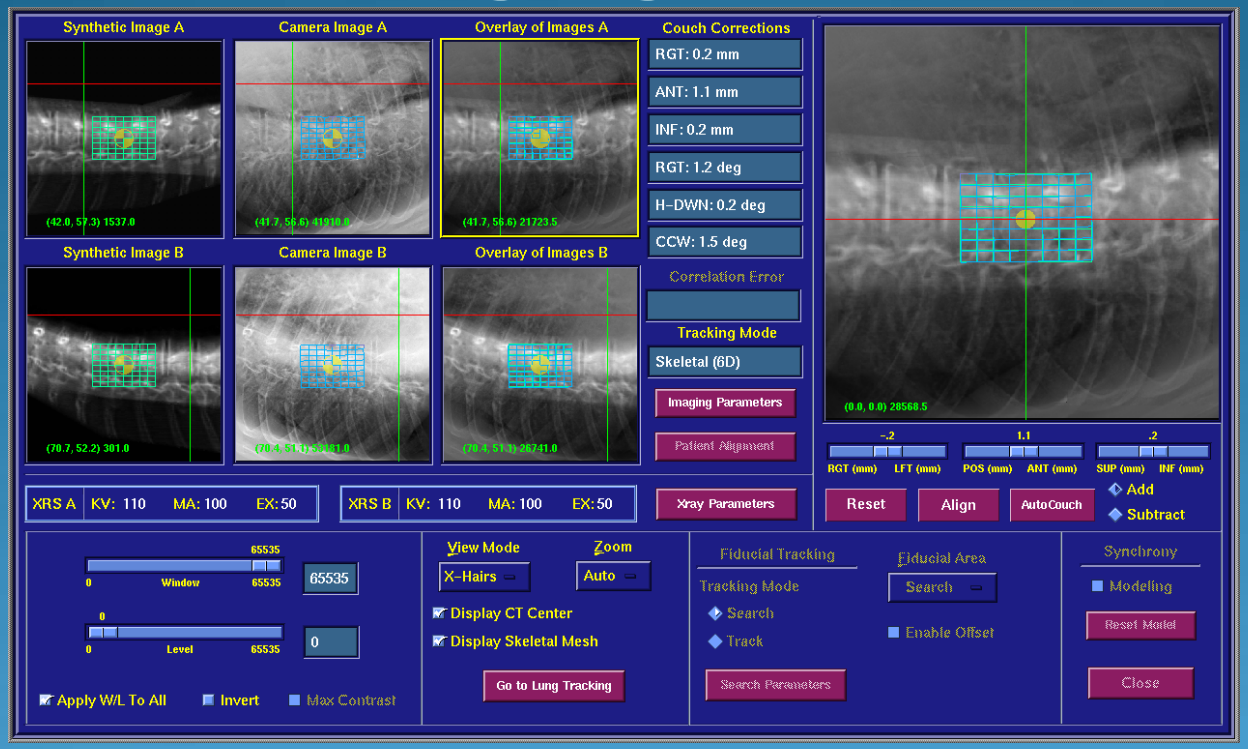
QA for Individual System Components: Imaging System

- Stability of Geometry
- Generators and Sources
- Amorphous Si detectors
- Patient dose from image guidance (TG-75)

Parameter	Method	Tolerance	Suggested Frequency	Reference
Filtration	First Half Value Layer	> 21 CFR, 1020.30	Annually	AAPM Report 14, Part 3, page 85; AAPM Report 74, Section 5.2.1
kVp Accuracy	Non-Invasive kVp meter	+/- 5% or = or better than manufacturers specifications	Annually	AAPM Report 74, Section 5.3.1
mA Station Exposure Linearity	Diagnostic Ionchamber	Adjacent mA stations within +/- 20%	Annually	AAPM Report 74, Section 5.3.3, AAPM Report 14, Part 3, p 84
Exposure Reproducibility	Diagnostic Ion chamber	Coefficient of variation < 0.10	Annually	AAPM Report 74, Section 5.3.3, AAPM Report 14, Part 3, p 84
Focal Spot Size	Slit Camera or star pattern	NEMA Standard XR 5-1992 (R1999)	At ATP then as required	NEMA Standard, AAPM Report 74, Section 5.2.6
Imager Position Reproducibility	Isopost tip	+/- 2 pixels	Quarterly	Accuray test procedures in conjunction with field service
Bad Pixel Statistics	Accuray Field Service	Bad Pixels less than max limit, number and position	Quarterly	Accuray test procedures in conjunction with field service
Other predictive Imager Tests, SNR, CNR, Gain Stability	To Be Determined	Reproducible	Monthly, TBD	

Table 1: Imaging System Related Quality Assurance

QA for Integrated Systems: Imaging/Software



- Which image artifacts have what effect on tracking algorithm?
- QA is usually done in good alignment – SHIFT your E2E phantom!
- Phantoms are easier to track than patients

QA for Integrated Systems: Imaging/Software

- Essential to ensure accuracy of image guidance
- Available Resources:
  - Reports #14 and #74 of TG 12 on diagnostic imaging QA
  - AAPM TG 75
- Obvious challenges:
  - Training in diagnostic imaging QA
  - Availability of diagnostic tools
  - No manufacturer recommendations
- That we do not know how to do it now does NOT mean we can ignore the issue!

QA for Integrated Systems: Accuracy of Radiation Delivery

1. Robot Mastering (by manufacturer)
2. 1st order: uses beam laser on isocrystal
3. 2nd order: fine-tunes 1st order calibration
4. Commissioning document specifies <0.5mm average rms error per path (~40 nodes)
5. Robot pointing has been shown to be stable by repeated use of srch2 for up to 2 years (longer data not available)
6. Problems:
   - laser as a substitute for beam (SU-FF-T-299)
   - Calibration checkto users except visual BB check

Overall System QA: Patient-Specific/Like QA: Why?

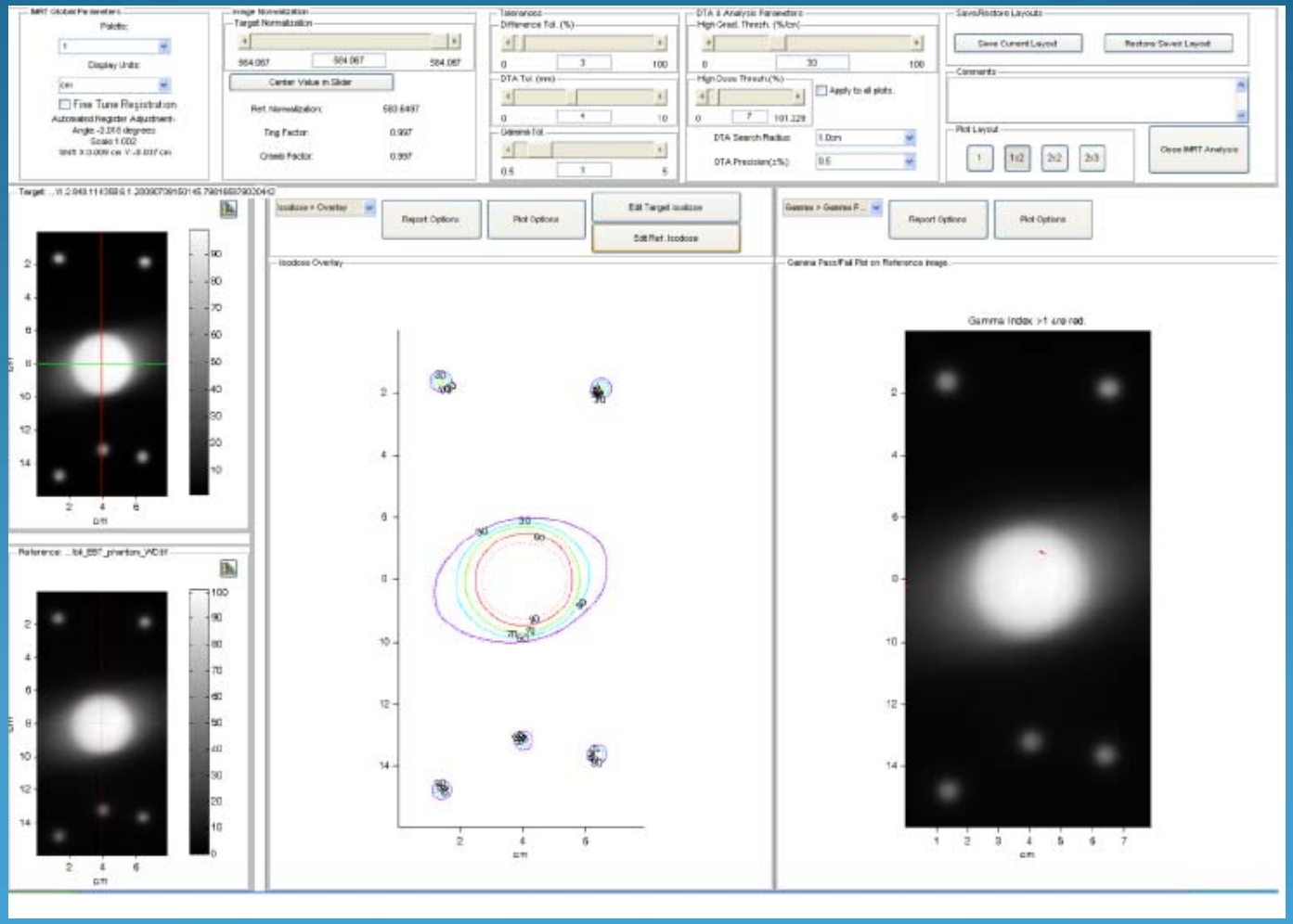
- It is the **only** non-isocentric QA test
- It tests all aspects of technical delivery
- Develop pass/fail criteria:
  - What is your case mixture: trigeminals, prostates …
  - RTOG protocols for SRS/SBRT are good guidance
  - Your own expectations
- AND it tests your complete **clinical process**

Overall System QA: Patient-Specific/Like QA: How?

Take anthropomorphic phantom and run a mock treatment, including all processes:

1. RTT does simulation
2. Plan non-isocentric
3. In “Patient” mode
4. Have MD approve
5. Do documentation
6. Have RTT treat
7. Analyze film (gamma-index)

This is Overall System QA:



Implementation of TG-135

- Technology changes since editing "lockdown":
  - IRIS collimator
  - MC for IRIS collimator
  - InTempo (change of prostate imaging)
  - Major database/software change
  - …
- Report should serve as Guideline, adapt to clinic
- Keep up with the literature on QA
- TG 100: Database? Process maps?