

AAPM TG 135 QA for Robotic Radiosurgery

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HANDOUTS

The slides of this lecture will be available
on the AAPM Virtual Library.



TG 135 Structure

- Introduction
- QA for individual system components:
 - Robot & Room
 - Accelerator
 - Software
 - **Imaging Subsystem**
- QA for integrated systems:
 - **Tracking System (Software & Imaging)**
 - Accuracy of Radiation Delivery (Robot & Accelerator)
 - **Overall Accuracy** (all subsystems)
- Summary & QA tables

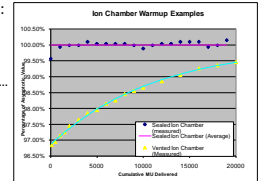


TG 135: QA FOR INDIVIDUAL SYSTEM COMPONENTS



Accelerator

- Differences to regular linac make QA easy:
 - No flattening filter (Tomo, TrueBeam)
 - Fixed & IRIS collimators
 - X-band
 - No bending magnet, wedges, electrons, MLC ...
- Small field dosimetry (TG-51)
 - IAEA concept paper: Alfonso et al, Med Phys (2008), 5179
 - TG-51 for machine-specific reference field
 - Summarized findings of current publications:
 - Chamber selection
 - k_Q
 - Interpolation based on BJR



Imaging System

- Stability of Geometry
 - Construction
 - Earthquakes
- Generators and Sources
 - mA drift causes changes in gradient gain
 - kVp, exposure seem to be more stable
- Amorphous Si detectors
 - Bad pixels going over limit affect tracking
 - Tracking algorithms vary in sensitivity to bad pixels
- Patient dose from image guidance (TG-75)

Parameter	Method	Tolerance	Suggested Frequency	Reference
Filteration	Fixed Head Value Log	± 2% CFR, 100/10	Annually	AAPM Report 14, Part 1, page B5; AAPM Report 16, Section 3.1.1
kVp Accuracy	Non-Invasive kVp meter	± 1% at 100 kVp	Annually	AAPM Report 16, Section 3.1.1
mA Accuracy	Diagnostic, Diagnostic/Reference	± 1% at 100 mA	Annually	AAPM Report 16, Section 3.1.1
Exposure Reproducibility	Diagnostic, Diagnostic/Reference	± 1% at 100 mA	Annually	AAPM Report 16, Section 3.1.1
Fixed Spot Size	Use Camera or ray pattern	NEMA Standard: ± 0.10 mm	As Appr. or Impromptu	NEMA Standard, AAPM Report 16, Section 3.2.2
Image Receptor	Inspect tip	± 0.1 mm	Quarterly	Accuracy of geometry in comparison with BDR service
Bad Pixel Statistics	Accuracy Park Software	See User Manual	Quarterly	Accuracy of geometry in comparison with BDR service
Collimator	To Be Determined	Reproducible	Monthly, TBD	



Imaging QA example (SD)

- Measured position accuracy of pediatric head phantom as function of kVp and mA
- Noticed brightness gain was different by 0.05 – 0.08, tracking in parallel
- Asked service engineer to calibrate cameras
- Got a surprise!
- Do require the engineers to give you this data!

Nominal mA	Imager A	Imager B
25	14	18.8
50	24	40
75	38	54
100	75	87
150	111	125
200	154	172
250	182	193
300	223	245

How does this affect tracking accuracy?

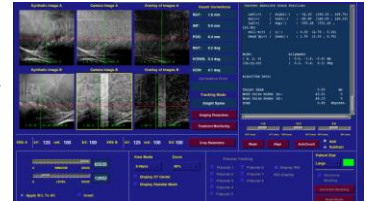


TG 135: QA FOR INTEGRATED SYSTEMS



Imaging/Software

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



Imaging/Software

- Essential to ensure accuracy of image guidance
- 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!

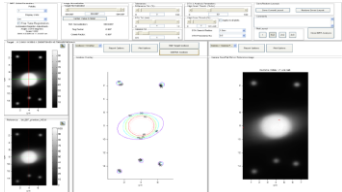


TG 135: OVERALL SYSTEM QA

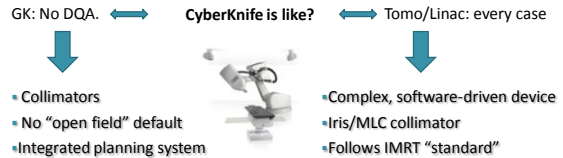


DQA (Delivery QA)

1. RTT simulates
2. Plan **non-isocentric**
3. In **"Patient" mode**
4. Have MD approve plan
5. Do documentation
6. Have RTT treat
7. Analyze film (gamma-index)
8. RTOG protocols for SRS/SBRT give good guidance for gamma



How often to do DQA?



TG135 DQA recommendations

- Every patient for:
 - New CK center
 - New treatment modality
 - Major software upgrade (e.g. 8.x to 9.x)
 - (SD opinion) Select patient population
- All other cases, 1-2 DQA per months:
 - Only non-isocentric test
 - Select challenging cases (NOT solitary round brain met!)
 - Keeps the procedure/skills up to date
 - Back-up should new QA knowledge emerge



Supervision Requirements (Errata)

We would like to correct a sentence on page 2932, Section III.E. General Patient Safety, *Treatment Procedure Monitoring*. The incorrect sentence reads: "We recommend that in addition to the treating therapist, a second medical professional (therapist, physicist, or physician) should be in the immediate vicinity at all times to assist when necessary."

Glossary:

Personal Supervision - Physicist is present at the treatment console

Direct Supervision - Physicist is in the department, available for immediate response

Corrected Text:

All treatments must occur under direct supervision of a QMP. In addition, a QMP must provide **personal supervision at the first treatment**, and as needed for subsequent treatments. The personal supervision should include participation in a time-out checklist, assessment of patient immobilization, assessment of adequate imaging parameters, tracking accuracy and correct Synchrony respiratory modeling (if applicable), consultation on excessive or unusual patient shift requirements during treatment not clearly caused by patient motion on the treatment couch, as well as other patient- or plan-specific needs.



Recommended Reading

“Engineering a Safer World – Systems Thinking Applied to Safety”

Author: Nancy G Leveson

Publication date: Fall 2011, MIT Press



The final word of advice ...

