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

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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)

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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!
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 E2E phantom!
- Phantoms are easier to track than patients

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. RTG protocols for SRS/SBRT give good guidance for gamma

How often to do DQA?

- GK: No DQA.
- Tomo/Linac: every case
- Cyberknife is like?
  - Collimators
  - "No open field" default
  - Integrated planning system
- Iris/MLC collimator
- Follows IMRT "standard"

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 2532, 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, assignment of adequate imaging parameters, 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...