Linac Commissioning Overview

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26 October 2017
Objective

• To provide an overview of linac commissioning process
  – Relates to ‘sensitivity to infrastructure’
Consider Basic 6 MV Linac with MLC, EPID & 3D CRT

- Assume technology is mature
- Steps in clinical implementation
  - Installation ... by vendor
  - Acceptance testing ... by Medical Physicist with vendor
  - Commissioning ... by Medical Physicist
  - On-going QC ... by MP, MP assistant, or RTT
Requirements for Clinical Implementation

• Qualified Medical Physicist
• Dosimetry tools
  – Calibrated ion chamber + thermometer, barometer
  – 3D water phantom, dosimetry scanning system
  – Additional ancillary tools: front pointer, level, ...
Acceptance Testing

- 3-5 days
- To prove accelerator meets specifications
- Radiation safety tests
- Interlocks
- Mechanical tests
- Light/radiation field tests
- Parameter readouts … collimator, gantry, couch, lasers
- Isocentre coincidence (radiation/mechanical)
- Beam energy, flatness, symmetry
- Dose delivery … reproducibility
Commissioning

• ~2-3 months
• Data for treatment planning system
• Beam calibration
• Depth dose
• Dose profiles
• Output factors
• Beam modifier or beam mode measurements
• Data for special procedures
  – TBI, stereotactic, ...
• Staff training
• Documented operational policies and procedures
• Procedures for scheduled & unscheduled down-times
Quality Control

• On-going tests to prove compliance
  – Daily (possibly by RTTs)
  – Weekly
  – Monthly
  – Yearly

• Documented process with tolerances and policies and procedures
  – What to do when measurements are outside of tolerance

• Responsibility … Medical Physicist
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A/S = Accelerator service staff  
R/T = Radiation therapy staff  

☐ Monthly QA of log done

(Date) __________   (Signature) __________
Other Options

• Multiple photon and electron energies
  – Similar data for TPS for each energy
  – Added QC
• IMRT/VMAT
  – See AAPM TG and other reports
  – Treatment planning integrity
  – MLC delivery
  – Patient specific QC
• IGRT
  – See AAPM TG and other reports
  – Geometric & image registration integrity

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**Task Group 142 report: Quality assurance of medical accelerators**
Eric E. Klein

**Quality assurance for image-guided radiation therapy utilizing CT-based technologies: A report of the AAPM TG-179**
Jean-Pierre Bissonnette
New Technologies

• **TomoTherapy**
  – Installed precommissioned
  – Acceptance testing is almost ≡ commissioning
  – Time from installation to clinical treatment much reduced

| QA for helical tomotherapy: Report of the AAPM Task Group 148<sup>a)</sup> |
|---|---|
| Katja M. Langen<sup>b)</sup> et al. |

Med. Phys. 37: 4817-4853; 2010

• **Varian Halcyon**
  – Similar precommissioning
    • Varian ... “accelerated installation timeframes, expedited commissioning, simplified training, and automated treatment.”

• Requires stable technologies with reproducible characteristics from factory to clinic
Linac Commissioning/QC

Summary

• Linac implementation and QC is challenging
• Common QA elements to fully loaded linac commissioning
  – Team effort
  – Training
  – Safety
  – Detailed commission measurements
  – Dose delivery accuracy
  – Detailed TPS commissioning
  – Image quality
  – Geometric fidelity
    • Scaling
    • Treatment-imaging isocenter coincidence
    • Registration/table shifts
  – Policies/procedures/criteria for adjustment