University of Michigan
Department of Radiation Oncology
Division of Radiation Physics

Linear Accelerator Acceptance and Commissioning Rotation

Resident: _____

Rotation staff mentor/ advisor: Kwok Lam, Don Roberts, and Choonik Lee

Rotation Duration: 2 months
Rotation Dates: _____

A medical physics resident in radiation oncology at the University of Michigan will be expected to demonstrate the following competencies associated with linac acceptance and commissioning. These are considered the minimum standards. Resident should complete the list of assignment during his/her rotations. The goal of this rotation is for residents to understand the process of installing a new linac, including selection and performance specification, acceptance testing, and commissioning.

Contents Outline

Knowledge Factors

- Reading assignments on the following topics:
  - Specifying a new linear accelerator
  - Linear accelerator commissioning

Practical Factors

- Perform the process of selecting a new linear accelerator and writing specifications as part of the purchase process.
- Learn about room design and shielding calculations.
- Understand how to select the equipment utilized for testing.
- Learn how to perform radiation surveys.
- Learn how to acceptance test a linear accelerator.
- Learn how to commission a treatment planning system for a linear accelerator.

Where possible, the resident will participate in all aspects of the acceptance of a new linear accelerator as part of this rotation. If a linac is not installed during a resident's training, this material will be covered in a combination of didactic and "lab" exercises.

Reading list:

1. F.M. Khan, The Physics of Radiation Therapy, 3rd Edition, Lippincott Williams & Wilkins, Copyright 2003.
2. AAPM Task Group #40, "Comprehensive QA for Radiation Oncology."
3. IPSM Report No.54, "Commissioning and Quality Assurance of Linear Accelerators"
4. B. A. Fraass, K. Doppke, M. Hunt, G. Kutcher, G. Starkschall, R. Stern, and J. Van Dyk, "AAPM Committee Task Group 53: QA for Clinical Radiotherapy Treatment Planning," Med Phys 25: 1773-1829 (1998).
5. C.J. Karzmark *et al.*, "Medical Electron Accelerators," McGraw-Hill Companies, Copyright 1993.
6.
7. P.Metcalfe, T. Kron, and P. Hoban, The Physics of Radiotherapy x-rays from Linear Accelerators, Medical Physics Publishing, Copyright 1997.
8. The Modern Technology of Radiation Oncology, Editor J. Van Dyk, Medical Physics Publishing, Copyright 1999.
9. C.J. Karzmark and Robert J. Morton, A Primer on Theory and Operation of Linear Accelerators in Radiation Therapy
10. Most current linac System Verification Summary (SVS) document.
11. Most current Customer Acceptance Procedures (CAP) document.
12. Sample request for proposal (RFP).
13. O'Daniel et al, "Volumetric-modulated arc therapy: Effective and efficient end-to-end patient-specific quality assurance." IJROBP 82: 1567-1574, 2012.

Knowledge Factors

Review and demonstrate an understanding of existing documentation on specification and selection of a linear accelerator, including ancillary imaging systems

Signature / Date	

Review a recent acceptance test procedure for a linac. Demonstrate an understanding of the purpose for each test and how the test is performed.

Signature / Date	

Demonstrate an understanding of the difference between acceptance and commissioning, and be able to describe the requirements for both.

Signature / Date	

Demonstrate an understanding of the distinctions between data for beam fitting and data for commissioning of treatment planning systems.

Signature / Date	

Discuss the necessary data required to commission IMRT/VMAT.

Signature / Date	

Discuss the acceptance and commissioning tests performed on ancillary imaging systems.

Signature / Date	

Demonstrate an understanding of the process of setting the treatment beam isocenter and its relationship to the gantry's mechanical isocenter, and on-board imaging system isocenter.

Signature / Date	

Demonstrate an understanding of the scope and accuracy requirements for commissioning algorithms prior to use for patient care.

Signature / Date	

Demonstrate an understanding of the connectivity requirements of linacs to txmt simulators, on-board imaging systems, record and verify systems, and electronic medical records systems.

Signature / Date	

Demonstrate an understanding of flatness and symmetry for photon and electron beams.

Signature / Date	

Define how the testing of an algorithm is related to the algorithm type.

Signature / Date	

Create a report documenting an aspect of treatment planning system commissioning for clinical use.

Signature / Date	

Demonstrate an understanding of photon and electron dose calculation algorithm (CVSP, AAA, CC, Pencil beam, eMC)

Signature / Date	

Practical Factors

The resident, with the approval of his/her rotation mentor, will select one section of the specifications of a previous linear accelerator's request for proposal (RFP) to update for new technology.

Signature / Date	

Perform and/or discuss the purpose of a treatment unit head wrap.

Signature / Date	

Performed a radiation survey on an existing linear accelerator, including a partial head leakage test and prepare a survey report. The resident will discuss the appropriate techniques and equipment used for such surveys.

Signature / Date	

Select testing protocol(s) in the acceptance procedure that is(are) different from routine QA protocol (annual QA, monthly QA etc.) and perform the test(s).

Signature / Date	

Able to setup the Wellhofer blue phantom for scanning, select the correct detector for measurement type, and use the effective point of measurements correctly.

Signature / Date	

Create a test methodology and define the dataset required to perform the test procedure for the calculation algorithm commissioning.

Signature / Date	

Perform the test calculations according to the procedure which was designed, and analyze the results.

Signature / Date	

Define a dataset and experimental conditions for the required measurements.

Signature / Date	

Perform measurements with the appropriate detectors and compare results with calculations. Measurement acquisition may involve support from others in the department (faculty, other residents, physics assistants).

Signature / Date	