AbstractID: 8350 Title: Quality Assurance of IMRT delivery systems - Siemens

Quality assurance issues surrounding the implementation of IMRT-MLC treatments are gaining interest due to the rapid expansion of IMRT treatment capability. Most new linear accelerators are being purchased as IMRT-ready devices and many older linacs are being retrofitted to be IMRT-capable. Recent changes in reimbursement patterns in the U.S. have contributed to both the increased interest in IMRT and in the Q/A measurements required to qualify for higher levels of reimbursement. This work will describe both machine-related and patient-related quality assurance considerations appropriate for IMRT delivery with a Siemens linear accelerator.

IMRT delivery with conventional MLCs for complex tumor-normal tissue configurations can involve large numbers of field segments, leading to many very small fields and low doses per segment. The operation of the linac under these conditions needs to be investigated prior to IMRT operations. In particular, dose linearity, flatness and symmetry must be tested under IMRT conditions. Conventional linac operations for non-IMRT would test only dose linearity down to 10 MU, but for IMRT we must investigate linearity down to 1 MU or even lower. For Siemens linacs, IMRT is performed only in step-and-shoot mode, where each beam segment is treated as a separate field. However, only integer MU can be specified at this time, so linearity must be investigated by comparing a measurement of 10 x 1 MU vs 1 x 10 MU, for example. The MU offset for each x-ray energy can be adjusted using a potentiometer and linearities of 1 % – 2 % can be achieved down to 1 MU. Since beam symmetry and flatness are passively set for large fields using only bending magnet current and position as well as flattening filter position, there should be no transient changes in flatness and symmetry for low MU exposures. Nevertheless, this should be verified by comparing flatness and symmetry at low MU with that achieved for conventional fields. Finally, the properties of the MLC need to be investigated prior to IMRT operations. The double-focused leaf end design and the arc-like motion of the leaves in the Siemens MLC determine the measurements to be done. These include leaf end leakage for closed leaf pairs, leaf position accuracy and offset at different gantry angles and penumbra, both in-plane and cross-plane. These measurements are needed for the treatment planning system in order to accurately calculate dose.

Patient-related quality assurance, though not directly dependent on the accelerator design, will also be discussed in this work. In particular, isocenter verification, intensity pattern verification and dose verification in a phantom (both multiple point and distributions) need to be investigated.

Educational goals for this presentation:

1. Understand differences between operations of the Siemens linear accelerator for conventional and IMRT
2. Understand differences between small field and large field treatments
3. Understand differences between large dose and very small dose treatment fields
4. Understand the effect of Siemens MLC design on IMRT treatment planning
5. Understand special requirement for patient-related quality assurance
6. Understand uncertainties of dose delivery accuracy for clinical IMRT treatments on Siemens linacs