AbstractID: 9341 Title: Benchmarking of an MMLC for Intensity-Modulated Proton Radiotherapy, with Emphasis on Secondary Neutron Dose

Purpose. We discuss the results of a feasibility study for multileaf collimator driven intensity modulated proton radiotherapy. The main focus is directed towards secondary neutron dose when using a miniature multileaf collimator. We also present a dosimetric comparison with conformal brass apertures.
Methods and Materials. Mechanical properties of an Integra Radionics MMLC were tested. The dosimetry of the MMLC in a fixed intra-cranial proton beamline was assessed by comparing depth and lateral dose profiles, as well as the conformity of 2D dose distributions. Neutron dose to the patient is a consequence of protons impinging on beam modifying devices, such as scatterers and collimators. Neutron dose was measured for both brass apertures and MMLC shaping at different distances from the aperture edge for varying proton energies, airgaps and field sizes. Activation of the MMLC leaves was quantified.
Results. Mechanical reproducibility and centering of the MMLC leaves are excellent. As expected we observe differences in dose distributions shaped by brass aperture and MMLC with regards to lateral fall-off, conformity and the field size dependence of the Bragg peak-to-entrance ratio. These differences are clinically negligible. Neutron dose depends strongly on particle energy, airgap, distance from isocenter and collimator material. It is increased for the tungsten MMLC, but the required increased airgap reduces the difference between MMLC and brass aperture. Because of the design of our intra-cranial fixed beamline the neutron dose is a factor of 10 to 20 smaller than in our passive-scattered IBA gantry system.
Conclusion. Extensive measurements proved that secondary neutrons do not prevent the implementation of intensity modulated proton therapy in our fixed beamline. Our results will furthermore be used as basis for the development of an MMLC dedicated for proton therapy.