AbstractID: 3707 Title: Monte Carlo investigation of dosimetric differences between SMLC and DMLC IMRT delivery techniques in heterogeneous media

Purpose: To investigate dosimetric differences between SMLC and DMLC IMRT delivery techniques in heterogeneous media using MC. We hypothesize that subtle differences in the energy spectra between SMLC and DMLC, which may not be detected in water, will be accentuated in inhomogeneous, patient-like tissues. With the ability to account for MLC design details and perform accurate transport in heterogeneous media, MC provides a powerful means to evaluate IMRT delivery methods and may be useful as a tool for IMRT QA.

Methods and Materials: The BEAMnrc code was used to simulate patient independent components of a Varian 21EX linac. The resultant Phase space file was then used as input for the DPM MC code which simulates the jaws, 120-leaf MLC geometry, and the patient or phantom. Transport through the jaws and MLC is accomplished using multiple scatter photon transport. Sampling algorithms have been developed for SMLC and DMLC by randomly sampling leaf segments based on the MU index. Accuracy of the simulations was assessed in a homogeneous media when compared to measurements in a solid water phantom. To assess the impact of MLC design and delivery technique in heterogeneous media, dose was calculated in a phantom consisting of material slabs ranging in density from lung to cortical bone using SMLC and DMLC leaf sequences.

Results: Excellent agreement was seen between the Monte Carlo models for SMLC and DMLC sequencing when compared to the respective film measurements in homogenous media. Significant differences, up to 10%, were seen between the delivery techniques in lung equivalent media when calculated in heterogeneous slab geometry.

Conclusions: This study provides evidence that heterogeneous tissue may exacerbate energy differences between SMLC and DMLC delivery methods. Such differences may be clinically important considering that they will not be detected during QA which is typically conducted using homogeneous phantoms.