AbstractID: 5570 Title: Use of the Monte Carlo method as a comprehensive tool for SMLC and DMLC-based IMRT delivery and quality assurance (QA)

Purpose: To report on use of a thoroughly benchmarked MC dose calculation algorithm as an accurate tool for IMRT delivery and QA, in patient-like media, where direct measurements for routine QA are impractical.

Methods and material: We have developed a source model to investigate dosimetric effects related to MLC based delivery techniques such as step-and-shoot and sliding window using the DPM MC code. The model incorporates details of the Varian, 120-leaf MLC and has been comprehensively verified against measurements in homogeneous and heterogeneous phantoms. As part of this development, we have investigated an efficient algorithm, using adaptive kernel density estimation for sampling phase space files. Using this accurate source model, we have studied beams that were sequenced with 1% and 10% fluence intervals for prostate, brain, head and neck and breast IMRT beams. Dose differences between SMLC and DMLC delivery types were evaluated in homogeneous and heterogeneous media (bone, lung and low-density slabs) using DPM. We have also investigated dosimetric differences between optimized planned leaf sequences and actual delivered sequences, using machine log (Dynalog) files, which capture the physical leaf positions during delivery.

Results: Benchmarking of the source model showed average agreement with measurements within 1%/2 mm. For a given fluence interval, calculated dose differences between SMLC and DMLC delivery techniques are different in homogeneous and heterogeneous media. Dose differences of up to 10% were found between plans developed with 1% and 10% fluence intervals for either SMLC or DMLC delivered sequences. Calculated dose differences of up to ±3cGy were observed between planned and delivered sequences (computed using the Dynalog files) for a prostate beam; these differences were in good agreement with film measurements.

Conclusions: A well commissioned MC-based dose algorithm provides a useful tool to study dosimetric issues related to fluence modulation and static versus dynamic delivery in IMRT.