AbstractID: 5704 Title: Leakage Characteristics of Two Common Multi-Leaf Collimators: Implications for Intensity Modulated Radiotherapy

Purpose: To evaluate leakage characteristics of two Varian MLCs during IMRT delivery.

Introduction: IMRT increases total body dose due to increased leakage proportional to the additional monitor units required. During MLC IMRT delivery, collimator jaws are positioned outside the edges of the entire intensity map, increasing the prevalence of leakage through and potentially around the MLC. The magnitude of the latter component is dependent upon the physical size of the MLC.

Method and Materials: The Varian Mark-I 52-leaf and Millennium 120-leaf MLCs have widths of 26 and 40cm, respectively, in the direction perpendicular to leaf motion. Identical, 1cm bixel-size small ($8x9cm^2$), medium ($12x16cm^2$), and large ($20x24cm^2$) intensity maps were delivered in SMLC mode with each MLC using 6MV photons. Ionization chamber measurements were performed outside these fields at the surface and 10cm depth in a patient-simulating phantom at 15, 20, 30, 40, and 50cm off-axis both along and perpendicular to the direction of leaf motion.

Results: Mark-I leakage in the leaf motion direction was very similar to Millenium-120 leakage in either direction. However, Mark-I leakage was considerably higher perpendicular to the leaf motion direction. This increase was apparent at all points, with a maximum of 100-150% at 20-30cm off axis for all fields. The average increase for all fields and positions was 90% at the surface and 65% at 10cm depth. Previous investigations have indicated significant risks of secondary malignancy induction associated with total body doses encountered in IMRT. Our results indicate that this risk is nearly doubled using a Mark-I MLC when the patient axis lies along the narrow dimension of the MLC.

Conclusion: The Mark-I MLC can profoundly increase total body dose in comparison to a wider MLC. This increase may be largely alleviated by judicious choice of collimator angle. This risk should be considered during IMRT planning.