Purpose: Investigate the error in IMRT dose delivery from changes in beam quality, symmetry, and MLC positional errors.

Methods: A complex (3533 MU, 216 segments, 0.181 modulation complexity score) H&N IMRT plan was delivered to the RPCâ€™s IMRT H&N phantom on a Varian Clinac 2100CD. The plan was delivered as a baseline and then again after adjusting the in-plane and cross-plane symmetry by 5% and 3%, respectively. The beam was adjusted back to baseline performance and the beam quality was hardened by nearly 2% (%dd) by altering the bending magnet current. The beam was then readjusted to baseline and the plan was delivered with MLC offsets of +1 mm and +3 mm. Radiochromic film and TLD within the phantom were used to analyze the 2D dose distributions and absolute doses.

Results: Relative to the baseline delivery, differences in absolute dose delivery of up to 0.6% and 3.2% were observed with changes in in-plane and cross-plane symmetry, respectively. The beam symmetry changes gamma analyses (Â±7%/4mm) resulted in a 0.4-11% change in the percent of pixels passing. The small change in beam quality resulted in a 6% average absolute dose and 24% pixel pass rate difference. MLC offsets of 1mm and 3mm resulted in average absolute dose differences of 12% and 32%, respectively, and a gamma analyses 21% and 33% change in pixel pass rate for each offset, respectively.

Conclusions: Accurate IMRT dose delivery is a long, complicated chain of events, each of which might contribute to dose delivery errors. Performing a risk-based FMEA analysis (presented by TG-100) to establish a QA program for IMRT requires knowledge of the error magnitude in dose delivery from key failure modes. Beam quality and MLC offsets resulted in the largest dose delivery errors. Additional failure modes are being investigated.

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