AbstractID: 9615 Title: Dual Focus Collimator Design Studies For Temporally Precise IMRT Delivery

Purpose: Increasing the temporal precision of IMRT delivery is hampered by current mechanical limitations. We are studying the feasibility of a novel system that would electronically modulate a radiation beam and deliver a time dependent IMRT beam by incorporating pencil beam scanning with a dual focus collimator. This design requires a sharply focused photon pencil beam (FWHM ~ 1 cm at 100 cm SSD), comparable to beams achievable with current LINAC technology. Collimator specifics were investigated using Monte Carlo (MC) techniques to evaluate the capability of producing photon pencil beams.

Methods and Materials: The BEAMnrc code was used to develop a geometry incorporating a novel 200 hexagon channel tungsten collimator. Simulations were performed varying collimator thickness, size, and spacing of the channels. Dose in water phantoms was calculated at depth of 10 cm using DOSXYZ. Similar MLC generated pencil beams were measured at equivalent depth using Computed Radiography (CR). Script files were written in MATLAB® to calculate peak output, FWHM, and off-axis dose/d_{max} ratios.

Results: Pencil beam FWHM and output decreased with increasing collimator thickness (2 cm collimator: FWHM = 1.5 cm, 9 cm collimator: FWHM = 0.6 cm), keeping all other factors constant, and compared favorably to the MLC pencil beam FWHM of 0.9 cm. Off-axis dose leakage ratios decreased 20% between 2 and 9 cm thickness. These ratios also decreased 20% with increasing hexagon spacing (0.25 - 0.75 mm). An 8-cm collimated (0.5 mm channel spacing, 0.43 mm radius) pencil beam (FWHM = 1.1 cm) matched closely the MLC pencil beam.

Conclusion: A dual focus collimator was designed using Monte Carlo modeling to produce photon pencil beams comparing favorably with current LINAC technology. Future work will focus on comparing theoretical isodose distributions to those of our clinical IMRT system.

Conflict of Interest: Research sponsored in part by Varian.