AbstractID: 10223 Title: Monte Carlo simulation and development of a multileaf collimator for proton therapy

Purpose: To develop a multileaf collimator (MLC) for proton therapy.

Method and Materials: We constructed a model of the IBA proton beam delivery nozzle at our facility with the Geant4 (v9.1) toolkit and, in partnership with Varian Medical Systems, employed it to optimize the shielding design for a multileaf collimator system. Simulation studies were carried out with the highest-energy, maximally-modulated spread-out-Bragg-peak settings and for the largest possible field size in both double scattering and uniform scanning modes. This led us iteratively to a solution that maintained proton and neutron leakage doses at an acceptable level.

Results: Our final design comprised 50 leaf pairs made from a tungsten-based alloy. Each leaf is roughly 9 cm high and 11 cm long—enabling 1.5 cm of overtravel—and projects to approximately 0.5 cm at isocenter; one half-height 450 μm side-step and two one-third-height 300 μm end-steps are built in. Maximum achievable field sizes are 16×16 cm^2 and 18×25 cm^2 respectively in double scattering and uniform scanning modes.

Conclusion: A MLC system has been designed for use in double scattered and uniform scanned proton therapy without significantly changing the standard IBA nozzle design or the mechanical and electronic systems currently used by Varian photon MLCs. Our simulations predict that the system will provide shielding at least as good as that provided by a conventional brass aperture. A prototype has been manufactured and is presently being installed on the nozzle in one of our gantry rooms. We expect to make measurements of leakage, penumbra and activation in the coming weeks and to validate our Monte Carlo simulations.

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