AbstractID: 5497 Title: Planning and Delivery of Dynamically Modulated Electron Radiotherapy

Purpose: Evaluate capabilities of modulating electrons using the installed multileaf collimators, computing modulated electron dose distributions using Monte Carlo (MC) and optimizing the dose distributions.

Materials and Methods: The modulated electron radiotherapy (MERT) evaluation was conducted with a Varian 120leaf MLC for 6-20 MeV. To provide a sharper penumbra, measurements were conducted with short SSDs (70-85cm). Aperture sizes (AS) ranging from 7-100mm (surface) were configured for measurements and modeling, using BEAMnrc MC code with $10^9$ particles incident on the exit window and DOSXYZnrc for phantom dose calculations. Parameter included: Voxel size $0.2x0.2x0.1cm^3$, photon and electron transport energy cutoffs 0.01MeV and 0.521MeV, respectively. Verification measurements were performed with film and micro-ion-chambers. Calculated and measured data were analyzed in MatLab. Once validation of static fields was successfully completed, modulated portals (segmented and dynamic) were configured for treatment and composed for calculation using DOSXYZ.

Results: Beam penumbra sharpness degraded with: decreasing energy and AS; and increasing SSD. PDD decreased significantly with AS. Nearly identical profiles when fluences were delivered by segmental and dynamic MLC sequences. The exception was in the peripheral and bremmstrahlung dose, which was higher in the segmented and dynamic deliveries, respectively. Calculations agreed with measurement within a distance-to-agreement of <3mm. With segmented delivery, we found it necessary to introduce small (~1.5mm) gaps between segments to retain ranges desired in the particular segment’s path. The treatment time to deliver 5 segments of 3 energies, was ~90s, including console reprogramming.

Conclusions: This study shows that MERT is feasible and provides conformal electron-beam dose distributions.

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