AbstractID: 3554 Title: Energy and intensity modulated electron radiation therapy using a Monte Carlo optimization procedure

Purpose: This study investigates the potential benefit of energy- and intensity-modulated electron radiotherapy (MERT) for superficial treatments and the possible intensity modulation by means of a multileaf collimator (MLC).

Method and Materials: Detailed Monte Carlo simulation is proposed for the pre- and post-optimization dose calculation for MERT treatment planning. We have used 1 x 1 cm^2 electron beamlets with different weights and energies that are optimized by an integrated inverse planner following the imposed constraints for the target and critical structures. A leaf sequencer proposes the necessary segments shaped by the MLC and then, in a second optimization, the segments are considered as new beamlets, called ‘blocklets’, by the inverse planner. Dose distributions for individual blocklets are simulated accurately by Monte Carlo taking into account the effect of bremsstrahlung leakage and MLC leaf scatter. The leaf sequencer provides the final RTP file to be read by the linac. MERT and mixed beam treatments for breast cancer have been planned following the two-step optimization criteria.

Results: The dose volume histograms (DVH) show clear improvement in the dose distribution before and after the second-optimization. The monitor units for individual segments are adjusted to correct for the effect of leaf leakage and scatter. A photon MLC has negligible leakage but more leaf scatter compared to an electron-specific MLC. The lung and heart doses are always less than 20 Gy and the best dose homogeneity in the target results from the two-step optimization.

Conclusions: An optimization procedure based on Monte Carlo has been developed to ensure accurate treatment planning and beam delivery with MERT. The Monte Carlo procedure is also useful in the investigation of the best collimation geometry by simulating existing photon MLCs and prototype electron-specific MLCs.