

Purpose: A new treatment technique has been developed for partial breast treatment using energy- and intensity-modulated photon and electron beams. Treatment plans for partial breast irradiation using this technique are investigated in this work.

Method and Materials: Two tangential photon beams with several electron beams of different energies and field shapes were used for partial breast irradiation. The patient setup and the orientations of the two opposed tangential photon beams were the same as conventional treatment for the whole breast. The electron beams were perpendicular to the patient skin surface. The dose-distributions for the photon beamlets and electron apertures were calculated by a Monte Carlo code, EGS4/MCSIM. The optimization was performed based on the Monte Carlo dose distributions employing a gradient search method. The photon beams were delivered using a multi-leaf collimator with a step-and-shot technique and the electron beams were delivered using cutouts. The effects of bremsstrahlung leakage and electron scattering by the cutout were taken into account in the Monte Carlo simulations.

Results: Treatment plans using this new technique for five breast patients were generated for partial breast treatment. Compared with multi-field photon IMRT, this new technique required no change for patient setup from the conventional technique and resulted in less dose to the ipsilateral lung and other normal tissues and less dose to the contralateral breast. Our results showed that the dose to the contralateral breast was reduced by about 50%. The volumes of normal tissues exposed to high and moderate radiation dose were reduced up to 50%. The doses to critical structures, such as the lung and the heart, were also reduced significantly.

Conclusion: The new treatment technique integrates intensity- and energy-modulated photon and electron beams and combines the advantages from both treatment modalities for partial breast treatment.