

**Purpose:** Total skin electron irradiation (TSEI) requires large electron beams having good dose uniformity,  $d_{\max}$  at the skin surface, and low bremsstrahlung contamination. Energy degraders and scattering foils have to be specially designed for the given accelerator and treatment room.

**Method and Materials:** Monte Carlo (MC) techniques based on EGS4 user codes (BEAM, DOSXYZ, and DOSRZ) guided the beam modifier design of our TSEI system. The dosimetric characteristics at the treatment distance of 382 cm SSD were verified experimentally using a linear array of 47 ion-chambers, a parallel plate chamber, and radiochromic film. By matching MC simulations to standard beam measurements at 100 cm SSD, the parameters of primary electrons were determined to be mono-energetic at 6.72 MeV, parallel, and circular beams having a Gaussian radial distribution with FWHM = 0.13 cm. They were then used to simulate our TSEI with eight sets of energy degraders and flattening filters.

**Results:** An energy degrader of a 0.6 cm-thick PMMA plate, blacking a jaw-shaped field ( $40 \times 40 \text{ cm}^2$ ) at 100 cm SSD, showed the best performance in terms of dose rate and uniformity. A flattening filter, consisting of a  $12 \times 12 \text{ cm}^2$  aluminum plate of 0.6 cm-thickness and placed just behind the energy degrader was considered optimal. Such optimized combination produced a beam that was flat within  $\pm 3\%$  up to 60 cm off-axis distance, dropped by not more than 6% at a distance of 90 cm, and had an x-ray of  $< 3\%$ . The maximum dose of the rotating phantom occurred at the surface and was approximately 40% of the maximum dose (at 0.65 cm-depth) of the stationary phantom.

**Conclusion:** By evaluating the dosimetric performance of beam modifier designs for TSEI, the Monte Carlo simulations reduced the costly efforts that could, otherwise, result from constructing and measuring lots of prototypes.