Purpose: Total body irradiation (TBI) techniques aim to deliver a uniform and accurate radiation dose to the entire anatomy of the patient. Given irregular patient shapes and internal inhomogeneities achieving a dose homogeneity within ±10 % of the prescribed dose represents a non trivial challenge.

We propose a novel TBI technique which is capable of delivering a more uniform dose to the entire patient than conventional TBI techniques.

Methods: Radiological depth calculations are performed along divergent ray lines through transverse CT slices of an anthropomorphic Rando® phantom. The radiological depths take into account both body contour variation and internal inhomogeneities. Based on the calculated radiological depths, multiple beam apertures can be generated using dynamic multileaf collimation (DMLC). To account for the scatter contribution, scatter kernels are derived using the concept of the scatter maximum ratios (SMR). Based on the scatter calculation the calculated beam apertures are modified. For dose calculation purposes the individual MLC files are imported into the Eclipse™ treatment planning system. However for treatment delivery, a single MLC file with multiple control points is generated and delivered while the phantom is translated on a motorized bed close to the floor through a stationary radiation beam with 0º gantry angle.

Results: In comparison to fixed open beam translating bed TBI the dose deviation along the midline was reduced from ±8% to less than ±4% of the prescribed dose with this new technique. Lung dose was reduced by more than 15%. Agreement between calculated and measured doses was better than 3% in Rando®.

Conclusions: A novel, aperture modulated translating bed TBI technique that employs dynamically shaped MLC defined beams has been developed for improving dose uniformity in three dimensions. In comparison with the open fixed beam TBI technique, the dose distribution homogeneity is greatly improved.