Purpose: Our institution delivers TBI using a modified Theratron 780 Co-60 unit. Due to limitations of our treatment planning system in calculating dose at extended SSDs, we have developed an algorithm for fast Monte Carlo simulation of dose to a patient receiving TBI treatment using our setup. The goal is to achieve a high accuracy dose calculation in heterogeneous tissue.

Methods: A custom Monte Carlo code was written in C to simulate energy deposition by 1.25 MeV photons over a broad field shape defined by our modified collimator on the Co-60 unit. A water phantom was constructed to measure dose delivered from the Co-60 unit using GafChromic film. A two-piece aluminum insert was fabricated to test the ability of the code to calculate dose near and inside a high density object. Dose measurements were made by placing GafChromic film inside the water phantom at various planes, with and without the aluminum insert, and compared to doses calculated by the Monte Carlo algorithm.

Results: Simulations in the water phantom accurately predict the depth of maximum dose in the phantom at 0.5cm. The measured PDD along the central axis of the beam closely matches the PDD generated from the Monte Carlo code, deviating by less than 5% from Dmax to a depth of 20cm. When the aluminum bar is introduced into the simulation, the dose measured at planes inside the aluminum had an average deviation on cross-profile of 4%.

Conclusions: The fast Monte Carlo algorithm is capable of accurately calculating dose in heterogeneous media. Depth-doses inside high density materials were accurately predicted, and further modification of the algorithm to include density information on a voxel-by-voxel basis should allow for the algorithm to provide clinically useful information in planning TBI.