AbstractID: 9014 Title: Presenting TomoPen: the first Monte Carlo treatment planning for Helical Tomotherapy

Purpose: Use a previously validated Monte Carlo (MC) model, called TomoPen, to evaluate the accuracy of the convolution/superposition (C/S) algorithm of Tomotherapy in a heterogeneous multi-layer phantom and in clinical cases.
Method and Materials: The C/S algorithm delivered by Tomotherapy is based on the collapsed-cone approach. In this algorithm, approximations are performed in the physics of transport of particles which may lead to significant deviations in inhomogeneous media. In the phantom study, an inhomogeneous phantom was build using two sets of slabs of low-density material (0.3 g/cm³) separated by two thicker slabs of water-like density material. The phantom was irradiated using three static fields with sizes of 1.25x2.5, 2.5x2.5 and 10x2.5 cm². Dose distributions were calculated by both C/S and TomoPen and compared to measurements made with EBT gafchromic films. This experiment enables to evaluate the capability of the C/S algorithm to handle loss of lateral electronic equilibrium effects. Clinical cases were also studied for various tumor locations and dose-volume histograms (DVH) obtained with C/S and TomoPen were compared. To ensure a "fair" comparison, all the calculations were performed using identical dose grid and DVH computation engine.
Results: In the inhomogeneous phantom study, good agreement (within 3%/2mm) was achieved between C/S, TomoPen and measurements proving that the C/S algorithm accounts for loss of electronic equilibrium effects. For the clinical cases already compared in this ongoing study, a very good agreement was generally achieved between TomoPen and C/S excepted for small lung tumors where differences up to 3% could be observed for the mean dose to the target volume.
Conclusion: Those results proved the ability of the C/S algorithm to compute accurately the dose in inhomogeneities but demonstrated also the potential of introducing TomoPen in clinical practice, especially for small lung tumors.
Conflict of Interest: Research sponsored by Tomotherapy incorporated.