Abstract ID: 15808 Title: Is AcurosXB^{TM} equivalent in accuracy to Monte Carlo for complex IMRT and VMAT dose calculations?

Purpose: To assess the accuracy of a new algorithm, a deterministic solution of the Boltzmann Transport Equations (AcurosXB^{TM}, Varian Medical Systems), in intensity-modulated (IMRT) and volumetric-modulated (VMAT) planning against a benchmark Monte Carlo system and a standard clinical algorithm (AAA, Varian Medical Systems)

Method and Materials: Four sites were chosen: prostate, lung, oropharynx and nasopharynx, each exhibiting characteristic challenges for planning. CT-based plans using 6MV IMRT and VMAT delivery were developed for each site and calculated as dose-to-water using Acuros v.11 and AAA v.10. Plans were exported to and calculated on a 36-CPU implementation of the EGSnrc-BEAMnrc MonteCarlo code with better than 1% statistical uncertainty. Dose and DVH differences were evaluated in the Varian-Eclipse environment for the target PTVs and relevant critical OARs.

Results: Dosimetric differences between Acuros and MonteCarlo were in general much smaller than between AAA and MonteCarlo. For Acuros, the greatest differences occurred in low density lung (densities < 0.1g/cc) or in air cavities, and were less than 5% of the target dose, extending over regions no greater than 5mm. Corresponding AAA differences were as high as 7% and extended for up to 10mm into higher-density tissues. As a result, the mean lung PTV dose difference was less than 0.5% for Acuros, but 1.7% for AAA. For the other three sites, the Acuros dose differences were within 3% over more than 97% of a representative volume defined by the 60% isodose contours. AAA dose differences were within 3% over 94% of the volume.

Conclusions: Within normal tissue-like materials (densities up to 1.6g/cc) and in complex clinical planning scenarios involving dynamic beam modulation, Acuros and MonteCarlo generally agreed within the statistical precision of the MonteCarlo dose calculations. Small discrepancies beyond this level could be attributed to differences in treatment head and MLC modelling between Eclipse and BEAMnrc.

Funding Support, Disclosures, and Conflict of Interest:

Partial funding provided through a research agreement with Varian Medical Systems