Purpose:

The Acuros XB (AXB) Advanced Dose algorithm (Varian Medical Systems) represents a dramatic shift in clinical photon dose calculation methodology from pencil-beam superposition/convolution methods. Early studies evaluating the accuracy of the algorithm in lung have found good agreement with both measurement and Monte Carlo based dose calculations. In this study, a dosimetric validation of Acuros is performed for clinical SBRT lung planning cases using Monte Carlo (MC) calculations as a benchmark.

Methods:

MC simulations using BEAMnrc/DOSXYZnrc were carried out for 8 AXB calculated 6/10 MV arc plans delivered on a TrueBeamTM STx linac in high-dose-rate flattening filter free mode. Clinical planning constraints were applied in each case with plans normalized to achieve 95% PTV coverage. Metrics used in the evaluation include: maximum and minimum GTV/PTV dose, PTV isodose coverage, conformity and dose profile comparisons. To understand the impact of moving toward to AXB calculations in SBRT lung planning, calculations using the Analytical Anisotropic Algorithm (AAA) are presented for each plan.

Results:

For both 6 and 10MV energies, consistent mean GTV dose and PTV isodose coverage was observed for AXB and MC calculations. GTV mean dose was observed to deviate by <2% for all cases. Isodose coverage for MC simulations ranged from 92%-98%. AAA was also in agreement with MC simulations within the GTV to within 2%. AXB and MC maximum and minimum PTV dose differences were larger (up to 9%) but not of clinical concern. In several cases, AXB exhibited a significant improvement in dose calculation accuracy in the lung region surrounding the GTV over AAA, particularly with lung densities < 0.1 g/cc.

Conclusion:

AcurosXB provides increased accuracy in modelling dose deposition for SBRT lung over AAA and is found to be in good agreement with MC calculations.