AbstractID: 8308 Title: Impact of Biological Optimization on Plan Quality: an Evaluation of a Commercial Treatment Planning System

Purpose: To evaluate the impact of biological optimization implemented in the new commercial IMRT treatment planning system (TPS) Monaco (CMS, St. Louis, MO) on plan quality as compared to a traditional TPS employing dose-based optimization (XiO, CMS, St. Louis, MO).
Method and Materials: Clinically used IMRT treatment plans for selected head and neck, prostate, and brain cases generated using XiO (version 4.3.3) were compared with corresponding plans generated using Monaco (version 1.0.0). The same CT data, contours, isocenter, number of beams (7-9), beam angles, and calculation grid spacing (2 mm) as in the original XiO plans were used for the Monaco treatment planning. Biological cost functions were used with parameter values suggested in a Monaco training manual as initial guesses. Iterative adjustment of isoconstraint values followed by re-optimization was continued until approximately 95% coverage of each target volume by a prescription dose was achieved. A Monte Carlo algorithm with 3% variance was used for final dose calculation in Monaco. Dose calculations in XiO were performed using a fast superposition algorithm.
Results: Monaco plans tend to result in smaller values of the mean dose and generalized equivalent uniform dose (gEUD) for OARs (15 out of 17 OARs in all plans combined) and greater mean doses and gEUD for targets (4/5). Maximum doses to normal structures are sometimes greater in Monaco compared to XiO (6/17) as a consequence of larger hot spots in target volumes. Dose heterogeneity was increased for all but one target in Monaco plans.
Conclusion: The biologically based Monaco TPS has the potential to generate superior IMRT treatment plans compared to the dose-based XiO TPS, as judged by better or equivalent target coverage accompanied by reduction in normal tissue exposure. However, greater dose inhomogeneity in the target must be accepted in most cases.