AbstractID: 8535 Title: Incorporating biological and spatial dose information can change the predicted outcome of radiotherapy treatment plans

Purpose: To incorporate structure radiosensitivity (α/β) and spatial dose variations (cell migration and daily setup uncertainty) into treatment plan evaluation for the Varian Eclipse Treatment Planning System (VETPS).
Methods and materials: Treatment plans were created using the VETPS from which Dicom RT files were exported to a Matlab-based interface for analysis. Spatial variation was modeled using a Dose Convolution Filter which applies Gaussian dose smoothing. Its effect on static dose distribution was evaluated theoretically by creating virtual dose matrices. 3D physical dose was then converted to equivalent dose in 2Gy fractions (EQD_2), thus incorporating relative radiosensitivity. Generalized equivalent uniform dose (gEUD) was then derived for each structure. Tumor control probability (TCP) and normal tissue complication probability (NTCP) were then calculated using Poisson and logistic models, respectively.
Results: Conversion of physical dose using DCF and EQD_2 can increase or decrease TCP or NTCP depending on the dose distribution and structure radiosensitivity, thus potentially changing the ranking order between plans. DCF application alone could result in changes of approximately 10% in TCP and/or NTCP. After converting static dose matrices to include spatial dose information and biological information (using the DCF, EQD_2, and gEUD formalisms), significant changes of 60% in TCP and 25% in NTCP were observed, respectively. Plans with similar DVHs may respond to the application of DCF and EQD_2 quite differently, thus significantly altering predicted TCP or NTCP and plan ranking between rival plans.
Conclusion: Treatment plan evaluation based on DVHs alone excludes both spatial and biological information about the dose distribution. Incorporating these spatial and biological parameters may significantly alter predicted TCP and NTCP and could also alter the ranking order of rival treatment plans.
Conflict of interest: Research partially supported by Varian Medical Systems.