AbstractID: 13984 Title: Controlling and refining 3D dose distribution at an individual voxel level in biological IMRT treatment planning.

Purpose: Biological treatment planning based on the equivalent uniform dose (EUD) demonstrates reduced treatment toxicity and better tumor control. However, EUD based approaches are lacking tools for controlling and refining resultant dose distributions on a voxel level. Here we introduce a method enabling regional dose distribution manipulations for biological IMRT treatment planning.

Method and Materials: Two dose distributions with the same EUD are EUD equivalent. However, one might be more clinically acceptable than the other. Embedding tools that find clinically more acceptable solutions and allow dose refining into biologic optimization is thus very important. We propose to use a hybrid biologic/physical dose optimization approach. We first identify region(s) where dose refinement is desired. For them a quadratic dose-volume objective function with a homogeneous prescription is formulated. The remaining structures are included into the planning via EUD dose constraints. If the resultant optimal dose distribution does not fulfill planner's clinical dose-volume criteria then the prescription is adjusted and the problem is re-optimized. The adjustment mechanism accounts for the intrinsic dosimetric inequality between voxels which is ignored by the EUD and the objective function.

Results: A clinical prostate case was used to test our method. The PTV was selected as a primary target for dose refinement. The rectum and the bladder were incorporated into the optimization via EUD constraints. By adjusting voxel prescriptions in the PTV iteratively, a dose improvement was obtained for the PTV and dose reduction was achieved in the critical structures comparing to a conventional dose-volume based objective plan with the same PTV coverage. For instance, we demonstrate up to 25% reduction in the mean dose to the rectum.

Conclusions: We show that regional dose distribution control and refinement can be achieved for biological optimization. It is relevant in the context of 3D dose sculpting based on the EUD.