AbstractID: 7575 Title: Exploiting dosimetric margins to reduce IMRT treated volumes

Purpose: To develop an IMRT optimization strategy in which CTV-to-PTV margins are iteratively reduced until the dosimetric margin distribution (DMD) meets a 90% population coverage criterion (PCC), with coverage being the percent of patients for which the CTV minimum dose is 100% or more of the planned PTV minimum dose.

Method and Materials: The DMD is the 3D margin distribution between the CTV and the treated volume (TV). Consistent with ICRU guidelines, the TV is the volume enclosed by the PTV minimum dose isodose surface. Optimization utilizes an iterative approach which converges on a DMD that exactly meets a 90% PCC. In each iteration, the DMD is obtained by exporting the CTV and TV as meshes, and calculating the margins between them via a computational geometry package. Coverage with respect to the PCC is computed based upon the DMD. In the next iteration, the PTV is re-created using a CTV-to-PTV margin determined via linear interpolation from prior coverage estimates to move the plan towards the desired PCC. Intensities are then re-optimized, and coverage is re-evaluated. Iterations continue until the 90% PCC is met.

Results: The proposed algorithm was run for a prostate IMRT plan. For 2mm simulated random and systematic setup errors, the algorithm yielded 3mm CTV-to-PTV margins, less than the 6.4mm margin prescribed by the van Herk margin formula (VHMF). While the DMD maintained the desired 90% coverage, the TV was reduced by 63% relative to a VHMF CTV-to-PTV margin plan.

Conclusion: To accommodate patient setup errors in a self-consistent manner, it is feasible and desirable to generate IMRT plans in which the DMD meets a population coverage criterion. DMDs assure the desired PCC is achieved and can result in lower treated volumes compared with traditional margin approaches. (Work supported by NIH R01CA98524)