

AbstractID: 13272 Title: High dose rate brachytherapy optimization based on the generalized equivalent uniform dose

Purpose: Dose inhomogeneity is inherent to high dose rate (HDR) brachytherapy treatment technique. The use of the generalized equivalent uniform dose (gEUD) in the objective function used for the optimization process is suggested as more effective in addressing inhomogeneity, compared to dose- or dose-volume- based objectives. The purpose of the current work is to introduce and study a gEUD-based objective function in HDR brachytherapy treatment planning optimization. **Method and Materials:** A gEUD-based objective function was used to optimize HDR prostate brachytherapy treatment plans for 12 patients. The quality of these plans has been compared to alternative, dose-based optimized plans, generated by HIPO, a commercially available optimizer, as implemented in Oncentra Prostate v3.1. The comparison was based on dose-volume-histograms (DVHs) and biological indices for each plan. **Results:** DVH comparisons between the two optimization methods indicate that the gEUD-based optimization model can lead to equivalent or better target coverage while better sparing the normal tissue structures than the dose-based optimized plans. Comparisons of the resulting gEUD values for each structure and plan showed a statistically significant improvement in normal tissue sparing (6.9% decrease in gEUD values for the bladder and 2.2% for the rectum on average) for the same or better target coverage (1.1% average increase in the gEUD values). **Conclusion:** The results of this study indicate that biologically-based optimization can significantly improve the quality of the treatment plan in HDR brachytherapy. Considering the very high doses per fraction delivered by this treatment method, better sparing of the normal tissue structures obtained by gEUD-based optimization may be of high importance for the patient's clinical outcome.