Purpose: To develop a VMAT optimization procedure using information from Multi-Criteria Optimization of IMRT plans and to perform a treatment planning comparison for prostate cancer patients.

Methods: IMRT plans using Multi-Criteria Optimization (MCO), 6 MV photons, 20 and 7 treatment fields were generated for 10 prostate patients in the RayStation treatment planning system (Version 2.2.13, Raysearch Laboratories, Stockholm, Sweden). The prescription dose was 7560 cGy to the prostate PTV and 5796 cGy to the seminal vesicles, using a simultaneous integrated boost technique. The resulting DVH parameters of the 20 field IMRT-MCO plan were used as initial optimization parameters for VMAT planning. The initial VMAT plan for each patient was further optimized by adjusting the optimization objectives/constraints. Final plan quality was compared using a homogeneity index (HI) and D98 for PTV-prostate, V70 and V75 for anterior rectum and V70 for bladder. Moreover, delivery efficiency of VMAT and the 7 field MCO-IMRT plans was also evaluated.

Results: All plans fulfilled the standard clinical objectives. The average HI of the PTV-prostate was 0.11 for VMAT, 0.13 for 20 field IMRT-MCO and 0.12 for 7 field IMRT-MCO, respectively. Average D98 values were 7191, 7294 and 7305 cGy for VMAT, 20 field IMRT-MCO and 7 field IMRT-MCO, respectively. For organ-at-risk (OAR), V70 and V75 for anterior rectum and V70 for bladder were within 3%. Analysis of delivery efficiency shows the estimated delivery time of VMAT is less than 2 minutes, while it is 7 min for 7 field IMRT-MCO.

Conclusions: MCO-informed VMAT optimization is a useful way to generate optimal VMAT plans. The resulting VMAT plan quality essentially matched the MCO-IMRT plan but with a shorter delivery time. Dose homogeneity of VMAT is slight superior compared to IMRT-MCO while the cold spots are slightly inferior. Furthermore, there is no clinically significant difference in OAR sparing.

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