

Clinical and theoretical quasi-IMAT study of prostate cancer to show high plan quality with a single gantry arc

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Purpose: Commonly IMAT treatment plans for clinical use can only be generated by forward planning. We present a quasi-IMAT technique, simulated by step-and-shoot treatment. The purpose of this study is to investigate, if the plan quality can be improved by increasing the number of beams, keeping the number of segments constant.

Materials and Methods: Quasi-IMAT plans with 18 and 36 equidistant beams were generated and the total number of segments was reduced to 36. In a second step the number of segments was increased to 72, in order to investigate if the quality of the plans as determined by DVHs of PTV and OAR improves with the number of segments. A conventional six-field IMRT plan was used as a reference. The beam setups were applied to the Carpet Phantom and to five prostate cancer patients. The plans were optimized with Oncentra Masterplan (version 3.0, DSS) for 15 MV photons and a MLC with 1 cm leaf width at isocenter. After optimization plans were normalized to the average of the PTV. For evaluation, DVHs for the plans with 18 and 36 beams were compared to the reference six-field IMRT plan.

Results: In the phantom case with the very concave PTV the percentage of the volume of the OAR that receives more than 70 % of the prescribed dose were 60.7%, 31.0% and 21.7% (for the 6, 18 and 36 beams plans with 36 segments). For the prostate cases, adequate dose coverage and dose homogeneity were accomplished inside the PTV. The average percentage of dose received by 50% of the rectum volume was reduced from 45% to 41.7% (6 and 36 fields with 36 segments). Only a slight improvement in OAR sparing was observed by increasing the number of segments. In all cases the dose received by the OARs was reduced by increasing the number of beams. This effect is more pronounced in the phantom, because the target is more concave. Simultaneously the coverage and dose homogeneity of the target is unaffected.

Conclusions: The advantage of quasi-IMAT technique is that it can be realized with a standard IMRT treatment planning system and a standard linac equipment. No special arc sequencing (Shepard et al., 2007) and dynamic leaf control is necessary. The plan quality is high even with a single gantry arc.

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