Automated iterative plan optimisation widens therapeutic window for prostate cancer arc therapy

E.J.L. Brunenberg1, J.M.A.M. Kusters1, P.G.M. Van Kollenburg1, C.M. Verhagen1, P.M.W. Van Herpen1, M. Wending1, R.J. Smeenk1, P.M. Poortmans1

1Radboud UMC, Radiation Oncology, Nijmegen, The Netherlands

Purpose or Objective: Treatment planning for volumetric modulated arc therapy (VMAT) is complex, as the result is highly dependent on the selected optimization objectives. The Auto-Planning module in Pinnacle3 9.10 (Philips Healthcare, Fitchburg, WI, USA) aims at offering efficient automated planning that directly uses clinical goals for iterative optimization, pushes beyond these goals if possible, and delivers consistent plan quality. In this study, we compared the performance of two Auto-Planning techniques with our original clinical approach of manually optimized prostate cancer VMAT plans.

Material and Methods: Techniques were evaluated for 23 prostate cancer patients (all treated using a rectal balloon), 18 of which underwent primary irradiation with a prescription dose (PD) of 70 Gy in 28 fractions. PTV (planning target volume) for these cases ranged from prostate only to prostate plus entire seminal vesicles. Five patients received salvage treatment with 65 Gy in 26 fractions.

Two Auto-Planning techniques (AP1, AP2) were compared with the manually optimized clinical plan (MP) to evaluate plan quality, focusing on PTV coverage and OAR (organ at risk) sparing. AP1 contained clinical goals for rectal wall, anal wall, bladder and femoral heads (dose-volume relationship and mean dose goals). AP2 used the same technique, excluding the femoral heads, in order to focus on bladder, rectal and anal wall (which are more prone to toxicity), and including a goal to minimize dose on tissue outside PTV and OARs. Monitor units (MUs) for all plans were scaled to achieve a V95% ≥ 99% for the PTV. One 10 MV VMAT arc (95 to 265° counterclockwise) and two portal imaging beams (for online position verification, 5 MU each) were used.

Results: Table 1 presents the results of the comparison. Both AP techniques show a significant increase in PTV mean dose and number of MU when compared to MP, while PTV max dose is not significantly different. With respect to OARs, Auto-Planning significantly spares all considered structures. AP2 indeed sacrifices sparing of femoral heads for more sparing of bladder, rectal and anal wall.

We selected AP2 as our Auto-Planning technique for clinical use. For 10 subsequently treated patients, AP2 resulted in an approved plan on the first Auto-Planning run for all 8 patients undergoing primary irradiation. The 2 salvage patients needed extra goals for the femoral heads.

Conclusion: Besides its efficiency and consistency, Auto-Planning offers similar PTV coverage as the original clinical plans, combined with better sparing of bladder, rectal and anal wall. Thus, the module widens the therapeutic window and is now used as our clinical standard for prostate cancer VMAT planning.

Table 1: Comparison of manually optimized (MP) and Auto-Planning (AP) techniques: mean and standard deviations for 23 patients. *p<0.05. **p<0.001. **p<0.001 (significant difference between AP1 and AP2, two-sided paired t-test used, p<0.05).

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mARC treatment planning in non-dedicated systems: two conversion approaches using IMRT and SmartArc

Y. Dzierma1, N. Licht1, I. Norton2, F. Nuesken1, C. Rübe1

1Universitätsklinikum des Saarlandes, Department of Radiation Oncology, Homburg/Saar, Germany
2Philips Healthcare, Philips Radiation Oncology Systems, Zürich, Switzerland

Purpose or Objective: The modulated arc (mARC) technique is Siemens analogue to volumetric modulated arc therapy (VMAT), with a different underlying principle and technical implementation. While this presents the only available rotational technique for existing Siemens users, only few treatment planning systems (TPS) are capable of mARC planning. In particular, the widespread Philips Pinnacle TPS does not support mARC. The purpose of this work is to present two solutions for mARC plan creation starting from either IMRT or SmartArc plans.

Material and Methods: In the first approach, the user creates a step-and-shoot IMRT plan with any number of beams ordered either clockwise or counter-clockwise, and one segment per beam. If desired, a few beams with more than one segment can be included. This plan is then exported as RT-Dose and an in-house software is used to modify the file in such a way that it is interpreted by the linac as an mARC plan. For this aim, each single-segment beam is converted into an arclet of a user-specified length (usually 4°). The calculated dose distribution of the IMRT plan corresponds to the mARC treatment, because mARC dose is usually...