based optimization engine, in locally advanced rectal cancer (LARC) IMRT plans in terms of planning target volume (PTV) coverage and Organs at Risk (OaRs) sparing.

Material and Methods: Between January 2014 and March 2014, 60 previously irradiated patients with LARC were retrospectively recruited: 40 IMRT plans were selected to configure the Dose Volume Histogram (DVH) model and to train it. The remaining 20 were firstly manually optimized by 2 medical physicists and then used to validate the model as benchmark plans (BP). OaRs constrains followed Quantec guidelines. Three model based on different PTV objectives have been generated: DVH model 95-105%, DVH model 98-105% and DVH model 100-103% with more than 95%, 98% and 98% of the PTV received more than 95% of the prescription dose and less than 5%, 5% and 3% of the PTV received more than 105% of the prescription dose, respectively. The performances of automated plans (one series for each model) vs BP were statistically compared using Wilcoxon signed-rank test, for PTV V95 and V105, hot spot out of PTV (HToPTV), bladder mean dose (BmD) and maximum dose (BmD), bowel mean dose (BoMD) and V45 (BV45). Two expert radiotherapists (observer1 and observer2) clinically validated in double blind the IMRT plans.

Results: A statistical significant improvement was observed for the following dosimetric parameters: HToPTV (for DVH model 98-105 and DVH model 98-103 plans, p=0.002 and p=0.005, respectively); BoMD (DVH model 95-105 and DVH model 98-105 plans, p=0.01 and p=0.03, respectively). A statistically significant disadvantage in terms of BmD was observed for DVH model 98-103 and DVH model 98-105 (p=0.02 and p=0.05, respectively). No statistical differences were recorded in term of BV45 and BoMD and PTV V95 and V105. (TABLE 1) At a clinical validation, the two observers most frequently chose the test plans optimized from DVH model 98-103% (34 times versus 26 times of the BP).

Conclusion: The results of this study show dosimetric and clinical improvements of IMRT plans optimized by knowledge-based planning models compared to BP. The data suggest and encourage the application of this engine into daily clinical practice.

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Dose assessment of coplanar and non-coplanar beam angle optimization algorithms

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Purpose or Objective: To assess the performance of coplanar and non-coplanar beam angular optimization for two different algorithms integrated in a fully automated multicriteria plan generation system for nasopharyngeal tumour cases.

**Material and Methods:** A retrospective study including data of 40 nasopharyngeal cases was performed. In each plan, the primary tumour, up to 3 adenopathies, and ipsilateral and contralateral lymph nodes were irradiated with doses of 70 Gy, 59.4 Gy and/or 54 Gy delivered in 33 fractions, respectively. A ‘wish-list’ based on hard constraints and prioritized objectives for the target volumes and the organs at risk was tailored according to the local clinical practice. Seven coplanar equidistant angles (E7) were used in the standard plan. For each patient, this IMRT plan was compared to coplanar and non-coplanar IMRT plans with 5, 7 and 9 beam angles, optimized with a multicriterial beam angle optimization algorithm (A5, A7, A9), and an in-house derivative-free optimization algorithm (B5, B7, B9). Dose distribution quality for each plan was assessed through DVH analysis and a dose metrics weighted sum approach.

Results: Globally all generated plans presented a good dose distribution. On average, similar results have been obtained for both coplanar beam angle optimization algorithms. For non-coplanar beams, the best results were obtained with algorithm B. When compared with B coplanar cases, on average, slightly better results were achieved with non-coplanar plans for all number of beams (B5, B7 and B9). For algorithm A, on average, no relevant improvement was obtained with the non-coplanar optimization compared with the coplanar plans or the E7 plans. Despite these average results, in particular clinical cases, appreciable differences concerning organ sparing could be found. Up to 9 Gy difference in parotid sparing was achieved both with B9 and A9 coplanar plans when compared with E7 plans. This maximum dose sparing rose to 22 Gy when non-coplanar beams were considered. For the spinal cord, a maximum dose difference of 6 Gy was found between A9 and B9 both for coplanar and non-coplanar beam geometries. In the chiasm, B9 gave up to 5 Gy less than A9 in coplanar beams but this dose sparing for B9 rose to 35Gy for the non-coplanar geometry. For ears B5 non-coplanar plans achieved a better performance than A9 coplanar plans in 66% of the cases. For this structure, up to 15 Gy differences were found between B5 non-coplanar and A9 coplanar plans.

Conclusion: Using a dose metric weight sum approach two beam angle optimization algorithms were compared in a faster and systematic way. On average, both algorithms performed well for the tested clinical cases. However, the different beam angle optimization strategies intrinsic to each of the algorithms revealed to favour algorithm B for non-coplanar beam geometries while for coplanar beams no relevant differences were found between algorithms A and B.

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Multicriteria optimisation for whole-pelvic VMAT planning in prostate patients

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Purpose or Objective: A Multicriteria Optimization (MCO) algorithm for VMAT planning that can generate Pareto-optimal plans was recently implemented in the RayStation TPS. The user can generate a plan database with a defined number of Pareto-optimal plans and can explore tradeoffs between different objectives in real time. This study investigates MCO for semi-automated VMAT planning for irradiation of prostate including pelvic lymph nodes.

Material and Methods: CT datasets of ten patients with high risk prostate cancer were used for this study. For each patient, a two stage VMAT plan (6 MV Elekta Agility linac) was generated, consisting of a stage 1 plan delivering 50.4 Gy to the lymph nodes (PTV-LN) and 56 Gy to the prostate (PTV-P) in 28 fractions with a dual arc and a stage 2 plan delivering 22 Gy to the PTV-P in 11 fractions with a partial arc. The separation of the