Abstract

Evaluation of Iterative Lexicographic Optimization based Algorithm for Automated Treatment Planning of Prostate Cancer.

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Purpose: To evaluate and quantify the planning performance of a commercially available automated planning module with a lexicographic optimization-based algorithm in order to increase the medical physics department efficiency, achieve high quality radiation therapy treatment plans and reduce inter-planner variability for a random cohort of prostate cancer patients.

Methods and materials: Application of an automated planning routine against a sample of 12 previously treated patients was performed. For the first two patients 540 automated plans were generated to refine the optimization goals and determine a planning strategy. For the remaining 10 patients, a total amount of 460 automated plans (AP) for different radiation therapy techniques were generated by the use of Plan Explorer auto planning module (RaySearch® Laboratories, Stockholm, Sweden).

Clinical objectives were checked for the selected AP candidates and evaluated against the respective clinical manual plan (MP) created in Raystation TPS that were taken as base line. Plan evaluations considered selected dosimetric plan parameters. Target coverage, homogeneity index (HI), conformity index (CI), organs at risk sparing, efficiency of design and planned delivered times were compared between MP and APs. Quality assurance of MP and AP were performed in order to evaluate the dosimetric accuracy of VMAT automated plans.

Results: Lexicographic optimization-based algorithm implemented in Plan Explorer was able to produce plans of comparable clinical quality comparing to manual plans, meeting target coverages and organs at risk constraints for a random cohort of prostate cancer patients.
With equivalent Target Planning Volume (PTV) V95%, D98%, Dmax%, HI and CI, significantly improvements in organs at risk (OARs) sparing of the rectum, bladder and intestine were obtained, with averaged dose reductions for AP of 4.5% (Range: 7.1% - 2.7%); 3.5% (Range: 5.1% - 1.2%) and 2.7 % (Range: 5.3 – 0.2) respectively for organ mean dose parameter (*Figure 1*).

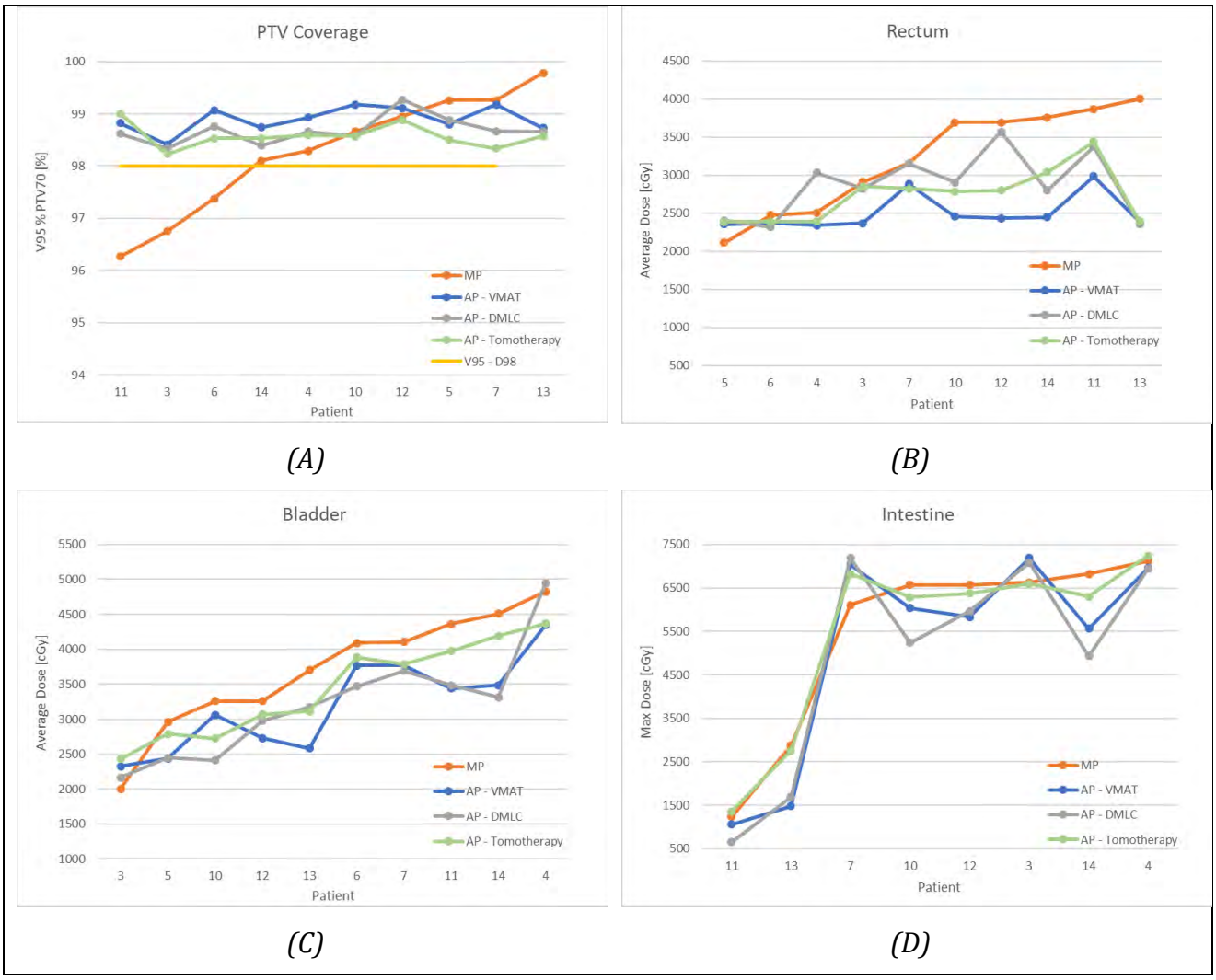

Figure 1: (A) Results for PTV coverage V95% PTV70Gy for MP and AP's. (B) (C) (D) Graphical results of comparison in OAR's sparing between MP and different techniques of AP Plan Explorer: AP-VMAT; AP-DMLC & AP-Tomotherapy for Rectum; Bladder & Intestine respectively.

Significant difference in the average number of monitor units (MU) were found between MP and AP, depending on the radiation therapy technique, therefore delivery times can be reduced considering clinical criteria. Not only active planning design overall time for AP was reduced of 55% with respect to MP, but also resources for AP optimizations were used during no working hours, allowing to increase the production and optimize the resources.

Conclusion: Plan Explorer can automatically generate acceptable clinical treatment plans for prostate cancer with either improved or similar results compared to manually created plans. Time reduction in plan design as well as human & computational resources optimization improves clinical efficiency.

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