



Can re-planning improve standardization? A multi-institutional SBRT prostate comparison



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Introduction and Objectives

Dosimetric and plan complexity quality metrics have been demonstrated to be essential for compliance assessment. Improving homogeneity between centers in multi-institutional studies can be challenging due to different Experience Level (EL).

The aim of this work was to preliminary evaluate the role of a re-planning phase in a multi-institutional study for achieving similar plan quality results and for further benchmarking.

Methods

In the 1st phase (Optimization I), 45 prostate SBRT plans from 9 centers were included. EL was ranked:

- EL 1 no experience
- EL 2 <100 SBRT prostate cases planned
- EL 3 ≥100 SBRT prostate cases planned

Each center was provided with 5 anonymized CTs with pre-delineated volumes and was asked to create SBRT plans according to pre-set dose constraints. Dose prescription was 7Gyx5fr. The DVH text file and the RP_DICOM of each plan were used to extract dosimetric parameters, modulation indexes, and dynamic parameters from IMRT/VMAT plans.

In the 2nd phase (Optimization II), planners were asked to re-plan the 5th patient, based on the median DVHs of all participants from the 1st phase, for improving target homogeneity and further sparing OAR doses.

Results

- In the 1st phase, EL correlated with dosimetric parameters (figure 1). The volume of rectum receiving > 32 Gy (V32 Gy, 9.1±4.4%) showed strong correlation with EL (p<0.0001): the higher the planner had experience level, the lower the doses to OARs were.
- When comparing only VMAT plans, the total Modulation Index (MI_{total}=0.70±0.21) was strongly correlated (p<0.001) with EL: the higher the experience level was, the lower the degree of plan complexity was reached.
- In the re-planning phase, the Kruskal-Wallis test showed significant differences in the doses to the rectum between the two phases (figure 2); no significant differences were found in the dynamic parameters of the plan and in the modulation indexes.
- The DVH sharing from the Optimization phase I improves standardization during the Optimization phase II (figure 3).

References

1) Marino et al—A feasibility dosimetric study on prostate cancer: Are we ready for a multicenter clinical trial on SBRT? · Strahlenther Onkol 2015, 191(7):573-81.

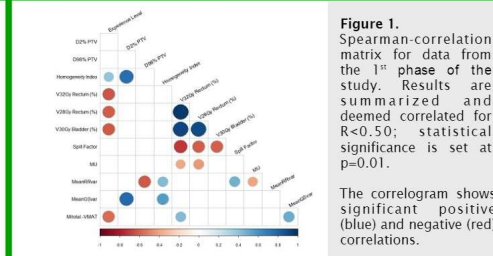


Figure 1. Spearman-correlation matrix for data from the 1st phase of the study. Results are summarized and deemed correlated for R<0.50; statistical significance is set at p=0.01.

The correlogram shows significant positive (blue) and negative (red) correlations.

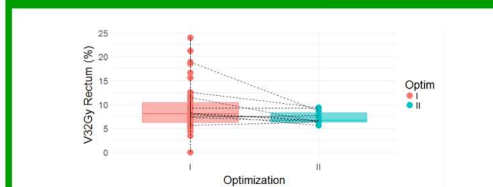


Figure 2. V32 Gy Rectum values (%) in the 1st phase (Optimization I) and after DVH sharing (2nd phase, Optimization II, re-planning phase). Black pointed lines connect values from the same center for the patient # 5.

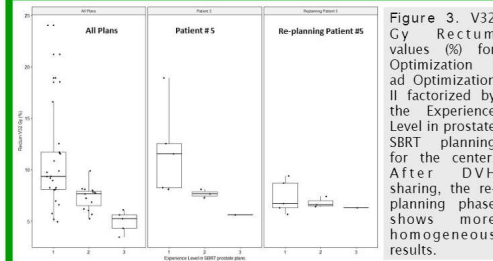


Figure 3. V32 Gy Rectum values (%) for Optimization I and Optimization II factorized by the Experience Level in prostate SBRT planning for the center. After DVH sharing, the re-planning phase shows more homogeneous results.

Conclusions

Planner's experience in SBRT prostate is correlated with dosimetric parameters and the modulation index MI_{total}. Complexity scores and dose distributions depend on specific dosimetric planning requests and replanning improves results in terms of homogeneity between centers whilst keeping the same level of plan complexity (MI_{total}): DVH sharing could aid in achieving better standardization. These results highlight the importance of training as well as the usefulness of a feedback strategy from multi-institutional comparisons.

Topic: Physics Track: Implementation of new technology, techniques, clinical protocols or trials (including QA & audit)

Keyword: Audits

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