Evaluating Treatment Plan Quality and Dosimetric Differences between Pinnacle³ Auto-Planning and Manual Treatment Planning in Brain Cancer Patients

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Introduction

Treatment plans for brain cancer patients tend to be complex in nature. There are many organs at risk (OAR) that can have significant consequences if over-irradiated. Additionally, the Planning Treatment Volume (PTV) could be wrapped around more than one OAR, thus making it difficult to maintain coverage of the PTV while sparing healthy tissue. The Pinnacle³ Auto-Planning feature allows for PTV coverage while minimizing the dose to OARs. The purpose of this study was to compare and evaluate the quality of treatment plans for brain tumors using Pinnacle³ Auto-planning versus manual treatment planning.

Methods and Materials

- Nineteen (n=19) patients previously planned using dual arc 6 MV VMAT technique in in Pinnacle³ TPS (Version. 9.10, Philips Medical, Fitchburg WI) then replanned using the Pinnacle³ Auto-Planning feature with two SmartArc beams utilizing a full arc.
- An Auto-Planning template was created with the same beam geometry, isocenter, and dose grid as the clinical plan. This method created Planning Risk Volumes (PRVs), which are 3mm expansions of the OAR.
- All plans were normalized so that 95% of the PTV received 100% of the prescription dose.
- Metrics for comparison used were D2%, D98%, homogeneity index (HI = D2% - D98% / Dmean), conformity index (CN), and fall-off (R25 = Prv25%/PTV, where Prv25% = isodose volume of 25% prescription dose) for the PTV and Dmax (0.03cc) and Dmean for OARs.
- Statistical differences were evaluated using a paired-sample Wilcoxon signed rank test with significance level of 0.05

Results

PTV:

- No statistically significant differences in the HI or the R25 fall-off
- CN showed an improvement of 7.15% (p<0.05) with the Auto-Plan over the manual plan

OARs:

- Auto-Plan showed a significant reduction in both the Dmax and Dmean to a majority of the structures.
- Higher Dmax to the brain stem and a higher to Dmean to the optic chiasm
- No statistically significant differences between the Dmax to the brain, Dmean of the spinal cord or Dmax and Dmean to the eyes.

Conclusion

Treatment planning employing auto-planning produces similar, if not better plan quality as compared to previously delivered clinical plans for VMAT based brain irradiation based on the metrics evaluated in this study. The use of auto-planning makes the planning process less time consuming and less planner dependent.

Table 1: Dosimetric summary between manual plans and auto-plans for OARs. Mean percentage differences for selected organs of manual plans to auto-plans (positive values denotes higher parameter value for manual plans) NS - Not statistically significant.