

A flexible RapidPlan model for optimization of high-grade glioma radiotherapy plans with and without hippocampal sparing

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EXECUTIVE SUMMARY

- We have trained a **RapidPlan** model for high-grade glioma that **includes hippocampal sparing**
- The model was trained on previously delivered RT plans that were replanned by an expert dosimetrist to include hippocampal sparing
- The model was evaluated on an unseen test set that was **optimized with and without hippocampal sparing**
- RapidPlan plans with hippocampal sparing were compared against plans generated by the expert dosimetrist
- RapidPlan plans without hippocampal sparing were compared against RapidPlan plans that included hippocampal sparing
- In 3/12 hippocampal sparing plans, the dosimetrist was able to meet clinical objectives that RapidPlan could not
- PTV/Global D_{max} was higher in RapidPlan plans** ($p=0.001$) compared to the expert dosimetrist
- Optic Nerve D_{max} was lower in RapidPlan plans** ($p=0.01$) compared to the expert dosimetrist
- Inclusion of hippocampal sparing caused comprised PTV coverage in 2/12 cases, but differences were less than 0.5%
- Hippocampal sparing in RT for high-grade glioma can be achieved using RapidPlan without compromising clinical plan quality

Introduction

- Evidence from randomized trials demonstrates improved memory, cognition, and quality of life in patients whose hippocampi are spared during radiotherapy (RT) to the brain [1]
- We present a RapidPlan (RP) model for high-grade glioma RT planning that includes hippocampal sparing (HS) and demonstrate that the inclusion of HS minimally impacts plan quality

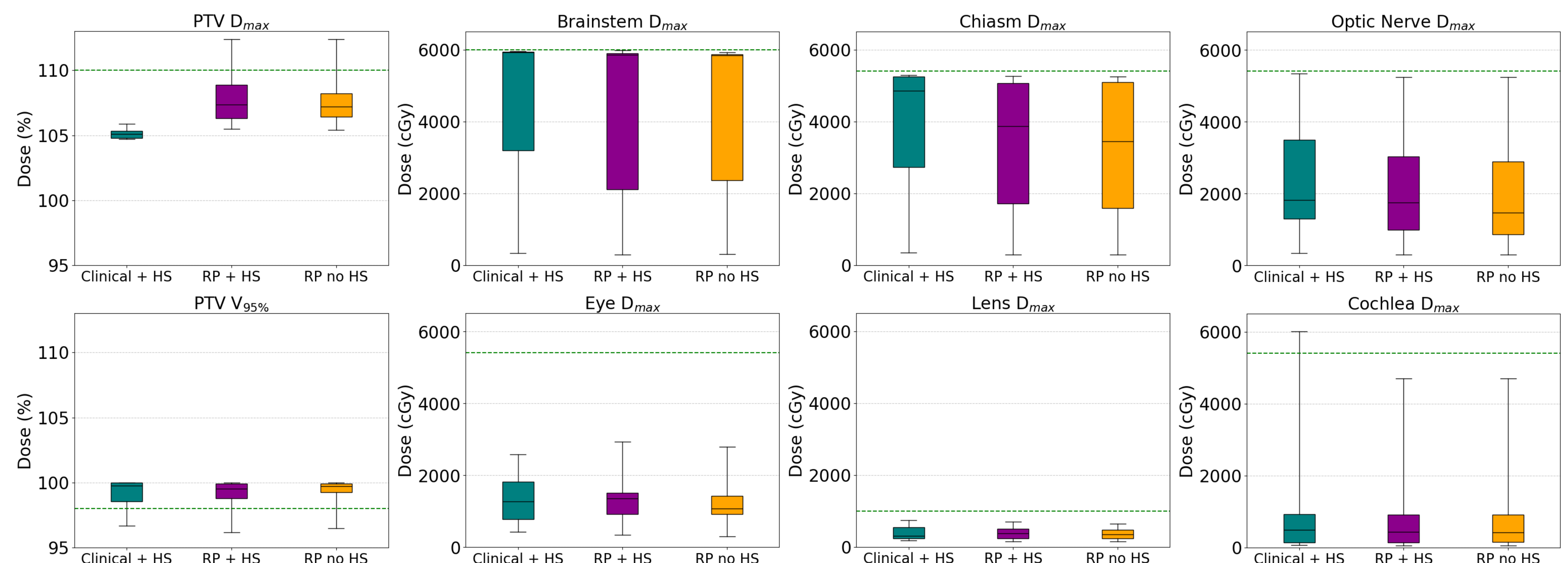


Figure 1. Boxplots of DVH metrics for plans optimized to include HS by an expert dosimetrist (green) or RapidPlan (purple) and by RapidPlan excluding hippocampal sparing (yellow).

Methods

- Model was trained on 53 high-grade glioma RT plans previously planned and delivered at our institution which were replanned with HS by a single expert dosimetrist
- The model was used to define optimization objectives and optimization was allowed to run without user input for twelve cases
- Plans were generated both with and without HS and compared against each other and the dosimetrist's HS plans
- Where the target volumes overlapped the ipsilateral hippocampus only the contralateral hippocampus was spared
- Statistical significance was tested using a Wilcoxon signed-rank test with $p<0.05$ threshold

Results

- In three out of twelve HS plans, the dosimetrist was able to meet clinical objectives that RP could not
- PTV/Global D_{max} was significantly higher in RP plans ($p=0.001$) and Optic Nerve D_{max} was significantly lower in RP plans ($p=0.01$)
- Plans without HS had significantly lower D_{max} values for Chiasm ($p=0.03$), Eyes ($p=0.001$), Lenses ($p<0.001$) and Optic Nerves ($p<0.001$) but HS plans still met clinical objectives

Conclusions

- Hippocampal sparing in RT for high-grade glioma has been successfully integrated into a RapidPlan model that generates high-quality plans in a single optimization
- The inclusion of hippocampal sparing does not significantly compromise clinical plan quality

References

[1] Gondi V, Hermann BP, Mehta MP, Tome WA. Hippocampal dosimetry predicts neurocognitive function impairment after fractionated stereotactic radiotherapy for benign or low-grade adult brain tumors. Int J Radiat Oncol Biol Phys. 2012 July 15;83(4):487.

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