

Rapid Automated Planning for VMAT Craniospinal Irradiation Using Raystation

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Purpose

- For craniospinal irradiation (CSI), VMAT offers superior dose conformity and normal tissue sparing compared to traditional 3D techniques. However, generating these plans is cumbersome. It requires multiple isocenters, optimization of a large number of organs-at-risk (OARs), and complexities regarding how to junction the beam sets together. We aimed to demonstrate the feasibility of rapid, automated VMAT CSI planning in Raystation.

Methods

- Raystation’s scripting environment was used to create a planning framework and GUI to rapidly plan VMAT CSI
- 7 prior CSI patients (3 adults and 4 pediatric) were re-planned using our auto-planning framework to a prescription 3000 cGy in 10 fractions
- The required user inputs were:
 - Prescription
 - CTVs for the Brain and Spine
 - Organ at risk contours
- Our framework can accommodate patients with a craniospinal axis up to 85cm using up to three isocenters
- All PTV creation, isocenter placement, planning-risk-volume generation, tuning/optimization structure generation, plan setup and optimization were performed automatically.
- For each plan, 2-3 beam sets/iso centers were used implementing 1 or 2 dose gradient junction regions (8cm in length) based on the technique described by Myers et al. (1)
- Beam sets are planned sequentially from superior to inferior with subsequent beam sets using the prior beam set as a background dose in generating gradient junctions to minimize the dosimetric impact of patient setup inaccuracies

Results

- PTV lengths ranged from 52-77cm
- 6 three isocenter plans
- 1 two single isocenter plan
- Plan generation took an average of 34 minutes (range: 19.2-41.5)

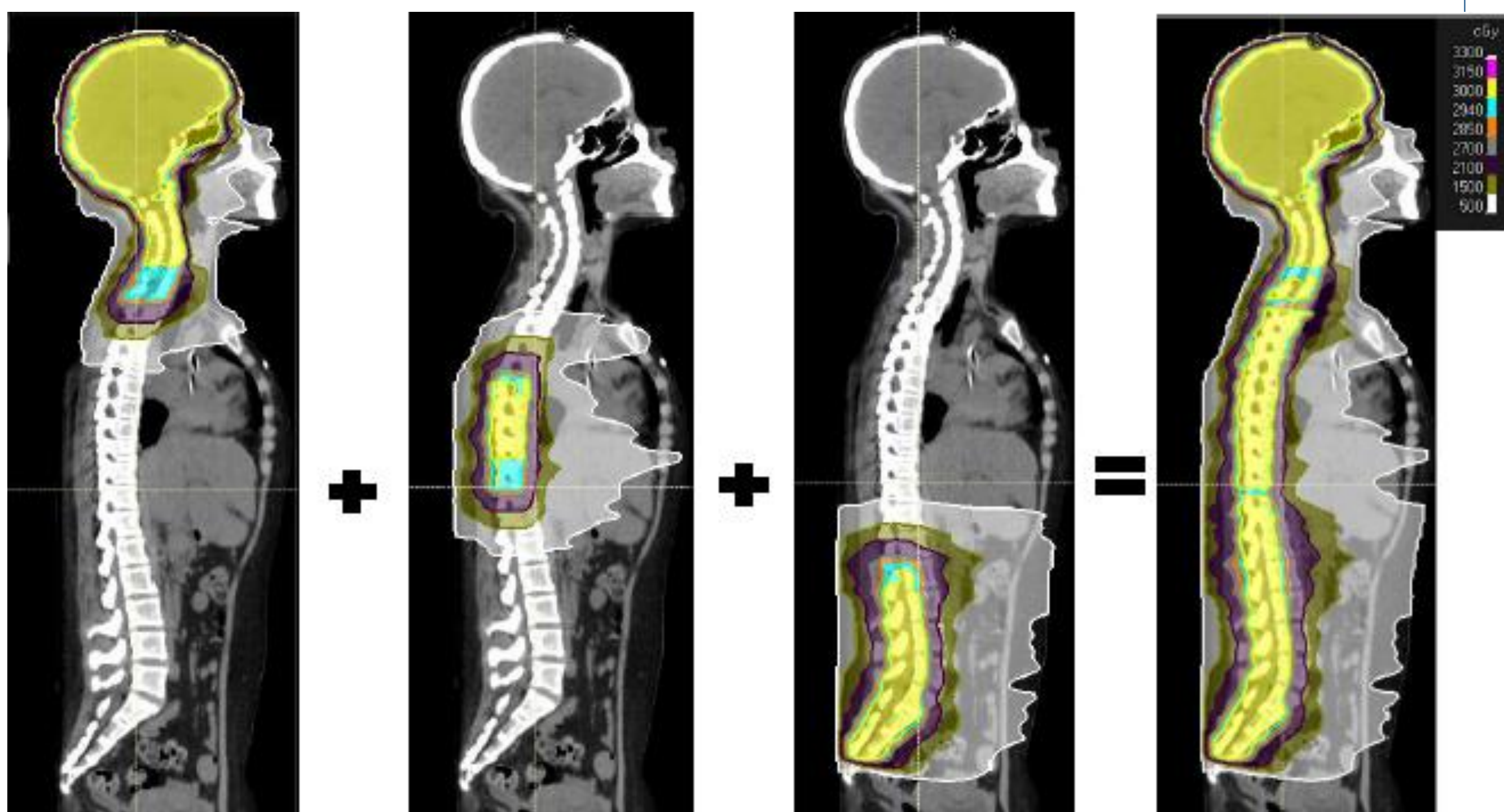


Table 1. PTV Dosimetry

	Conformity Index at 3000 cGy	%Volume at 2850 cGy	%Volume at 3000 cGy	%Volume at 3150 cGy
Average	0.96	99.5	94.3	0.73
Median	0.96	99.6	94.7	0.92
Min	0.94	99.3	92.9	0.20
Max	0.97	99.9	95.4	1.2

Table 2. Organ at Risk Dosimetry

	Lenses		Oral Cavity	Parotid Glands	Submandibular Glands	Larynx	Heart	Stomach	Liver	Kidneys
	Mean Dose (cGy)									
Average	761	689	747	668	1011	571	906	769	669	672
Median	766	641	722	631	1071	476	913	781	604	574
Min	685	613	581	528	679	348	788	690	541	424
Max	840	853	935	873	1251	1048	1078	825	978	1139

Conclusions

- Automated rapid (~35min) VMAT CSI planning is feasible
- Our framework produces high quality VMAT plans in less time (~35 minutes) compared to published literature (2,3)

References

- Myers P, Stathakis S, Mavroidis P, Esquivel C, Papanikolaou N. Evaluation of localization errors for craniospinal axis irradiation delivery using volume modulated arc therapy and proposal of a technique to minimize such errors. Radiother Oncol. 2013 Jul;108(1):107-13. doi: 10.1016/j.radonc.2013.05.026. Epub 2013 Jun 20. PMID: 23791305.
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