Whole Brain hippocampal sparring Volumetric Modulated Arc Therapy Vs Intensity Modulated Radiation Therapy Comparison

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INTRODUCTION

Neurocognitive toxicity represents a spectrum of different toxicities and the time course of these can
vary significantly. Intensity Modulated Radiation Therapy
(IMRT) and Volumetric Modulated Arc Therapy(VMAT) plans were created for Elekta Synergy Platform Digital Linear Accelerator (Elekta AB, Stockholm, Sweden) using Monaco

AIM

The aim of this study is to evaluate and compare hippocampal sparing whole-brain radiation therapy treatment planning techniques using volumetric modulated arc therapy and intensity modulated radiation therapy (IMRT)

METHOD

- 12 patients previously treated with whole brain radiotherapy, re planned with Volumetric Modulated Arc Therapy and Intensity Modulated Arc Therapy; in an effort to spare the hippocampus region.
- To delineate optic chiasm, optic nerve; magnetic resonance imaging (MRI) and computed tomography (CT) data acquisition and their fusion has been done.
- The hippocampus avoidance region was created by giving 5 mm margin to the hippocampus. RTOG 0933 recommendations were applied for the beam arrangement purpose and treatment planning.
- The prescription for treatment was 30 Gy in 10 fractions and the planning PTV was drawn incorporating the while brain including the hippocampus region.

RESULTS

- Dose to hippocampus by IMRT (DMLC) and VMAT are 1786.78±12.53 cGy and 1583.07±12.68 cGy respectively.
- The Coverage to PTV is almost identical for both the modalities 95.02% and 94.89 % by IMRT & VMAT respectively.
- The other OAR all have similar dose. The homogeneity index obtained for IMRT and VMAT plans are 0.183 and 0.196 respectively for IMRT and VMAT.

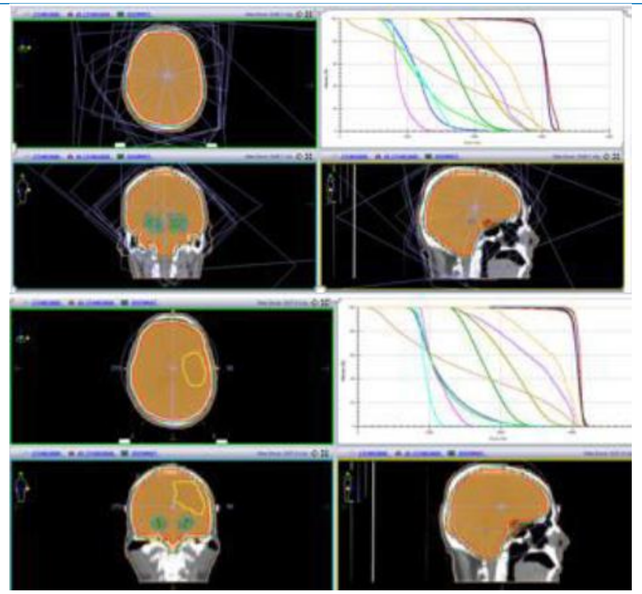

Fig.1. Plan comparison for Patient1 using IMRT (Top, DMLC) and VMAT (Bottom)).

		Min	Max	Mean	V95%	D2%	D98%	D50%	HI	Min	Max	Mean	V95%	D2%	D98%	D50%	HI
	Hippocampus	1178	2716.4	1776.4		2430.8	1271.7			966.1	3145.0	2346.0		2962.0	2961.0		x
	Brain PTV	1750.2	3398.7	3044.1	95.79	3191.3	2754.6	3061.5	0.143	2121.0	3276.0	3016.0	95.9	3195.0	3142.0	3039.6	0.017
	Optic Chiasm	2896.3	3233.6	3095.7		3207.9	2950.8			2974.0	3061.0	3117.0		3221.5	3221.0		
	Rt Eye	392.7	2863.5	1162.5		2611.7	454.6			454.1	2764.4	1035.3		2442.0	2442.1		
1	Rt lens	468	1474.6	741.7		485.5	1386.5			503.9	798.2	597.0		795.5	507.0		
	Rt optic nerve	1525.1	3019.9	2345.1		3008	1567			1234.8	3048.7	2271.6		3011.2	1286.1		
	Lt eye	623	2560.7	1231.6		2285.4	1231.6			497.8	2508.8	959.0		2079.4	554.3		
	Lt lens	714.1	1075.7	845.1		1003	726.7			539.0	836.0	638.0		809.3	555.9		
	Lt optic nerve	1758	3004	2402.9		2939.6	1794.4			1290.2	2892.0	2260.0		1310.4	2932.6		

A total of 24 treatment plans were created and evaluated for this case study. Each plan was optimized specifically for the 2 cases. The primary objective is to reduce the mean dose to the hippocampus while distributing the prescription dose to the rest of the brain. The radiation oncologist prescribed 30 Gy to the PTV.
Above Table is depiction of data for 1 patient only

CONCLUSIONS

- Dose to hippocampus was successfully reduced using 2 planning techniques viz. VMAT & IMRT (DMLC) techniques.
- The results from the planning comparison case study show that either planning technique can be used to achieve treatment planning goal of adequately reducing the mean dose to the hippocampus.
- However, VMAT plans provided a more homogeneous dose distribution throughout the PTV. The maximum point dose VMAT plans received was lower than that with IMRT plan. It is important to reduce the doses to these structures as much as possible based on ALARA principle

REFERENCES

- DeAngelis LM, Delattre JY, Posner JB. Radiation-induced dementia in patients cured of brain metastases. Neurology. 1989;39(6):789–96
- Lee, Katrina, Lenards, Nishele, & Holson, Janice (2016). Whole-brain hippocampal sparing radiation therapy: Volume-modulated arc therapy vs intensity-modulated radiation therapy case study. Medical Dosimetry, 41(1), 15-21. doi:101016/jmeddos201506003

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