Dosimetric Evaluation of a New Integrated SBRT/IMRT Treatment System

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INTRODUCTION

The seamless integration of functionality of different radiotherapy equipments holds promise for optimal treatment dose delivery and outcomes. Towards this end, we investigated a novel radiotherapy system, Taichi (OUR United RT Group, Xian, China), which combines a 6 MV linac head with a 120-leaf MLC (maximum field size: 40cm x 40cm) and a focusing Gamma ray head on the same rotating gantry. The Panther TPS (version 5.60.4657, Prowess Inc., Concord, CA) was commissioned for the new machine. A dosimetric comparison of SBRT/IMRT treatment plans generated using the Panther TPS and the Eclipse TPS (Varian Medical Systems, Palo Alto, CA) were performed for the same anonymized patients.

AIM

The Panther TPS is capable of generating SRS/SBRT treatment plans for the rotating Gamma ray system and 3DCRT/IMRT/VMAT treatment plans for the 6 MV linac, separately, or integrated treatment plans for both modalities. This study investigates the dosimetric quality of treatment plans for the Taichi treatment system by comparing treatment plans for patients previously treated on Varian accelerators.

METHOD

The Panther TPS was commissioned for the new machine in this retrospective study. Twenty previous SBRT/IMRT patients were unachieved from our clinical database, who were planned using the Varian Eclipse TPS and treated on Varian Clinac iX accelerators (Varian Medical Systems, Palo Alto, CA). Treatment sites included head and neck, lung and liver. The same optimization parameters and beam configuration were used in the re-planning process. Plan quality was evaluated using the homogeneity index, conformity index, D_{max}, D_{min} and D_{mean} for the target, and D_{max} and D_{mean} for organs at risk (OAR).
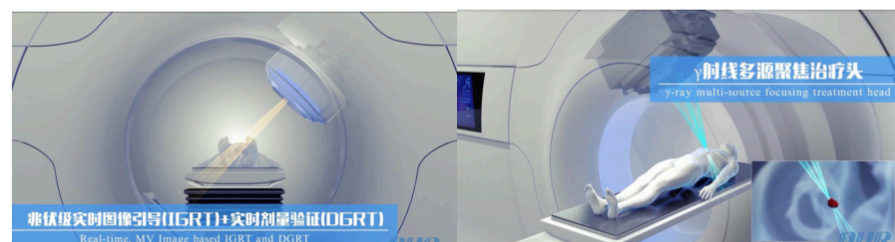

Figure 1. An integrated SBRT/IMRT Treatment System

RESULTS

All treatment plans generated by the Panther TPS for the new treatment system met our clinical acceptance criteria. For the same PTV coverage (D_p assigned to 95% isodose line), the mean HI and CI was 0.11±0.01 and 0.79±0.02 for Panther plans and 0.08±0.01 and 0.82±0.02 for Eclipse plans, respectively, and D_{mean} was within 2% between the two treatment systems. For plans of comparable quality, Panther/direct-aperture optimization (DAO) required less MLC segments and MUs compared with Eclipse/beamlet-based optimization. When target and OARs were in close proximity, DAO resulted in less homogeneous target dose (i.e., up to 5% higher D_{max}). Generally, Panther DAO optimization took marginally longer computing time than the Varian Eclipse system.
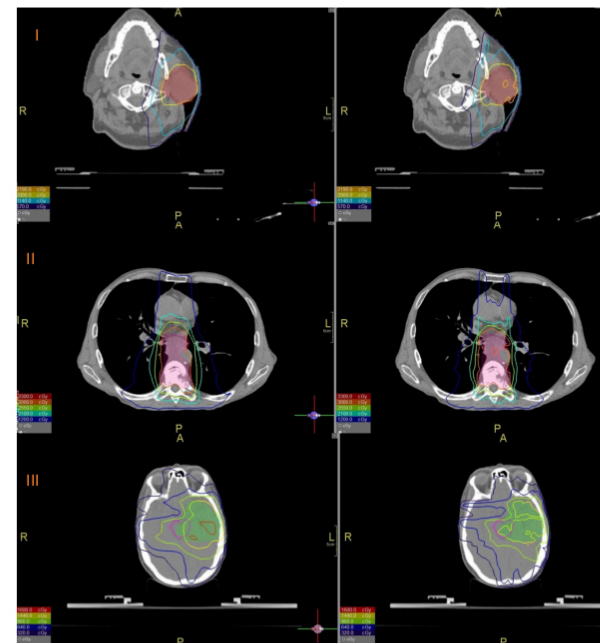

Figure 2. Representative isodose comparison between treatment plan of Prowess and Eclipse for(I) Parotid gland, (II) thoracic, and (III) brain.
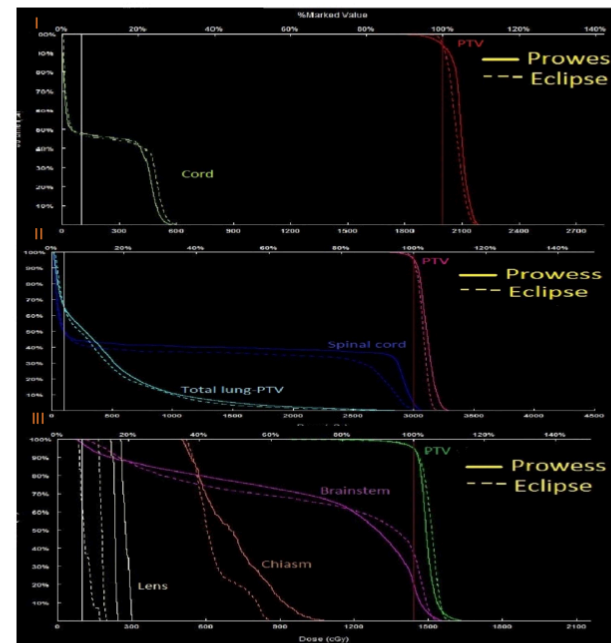

Figure 3. Representative cumulative dose-volume histograms of treatment plans generated by Prowess Panther and Varian Eclipse for (I) Parotid gland, (II) thoracic, and (III) brain.

Table 1. Comparison of dosimetric index.

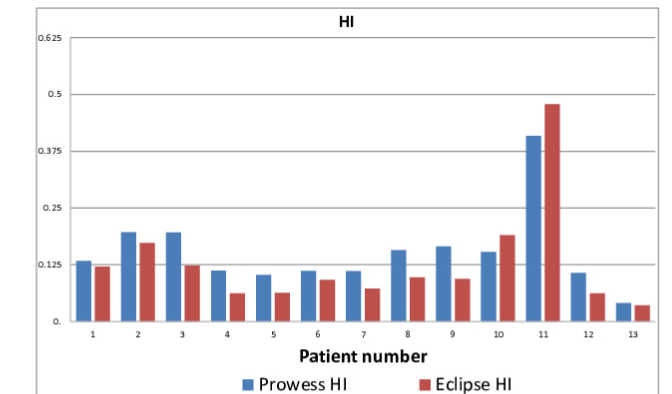| ROI	Dosimetric Index	Eclipse	Prowess	%Change
PTV	D_{max}	1.11±0.11	1.124±0.10	1.3
	D_{min}	0.96±0.04	0.96±0.02	0
	D_{mean}	1.05±0.06	1.06±0.05	1
	$V_{95\%}$	99.5±0.72	99.3±0.55	-0.2
	$V_{105\%}$	29.80±30.60	45.26±28.58	51
	HI	0.08±0.01	0.11±0.01	37.5
	CI	0.82±0.02	0.79±0.02	-3.7
NT	$R_{50\%}$	4.5±0.9	4.36±0.73	-3.1
	D_{2cm}	70.9±8.99	74.6±9.26	5.2

Figure 4. Comparison of homogeneity index (HI) for Prowess Panther and Varian Eclipse plans.
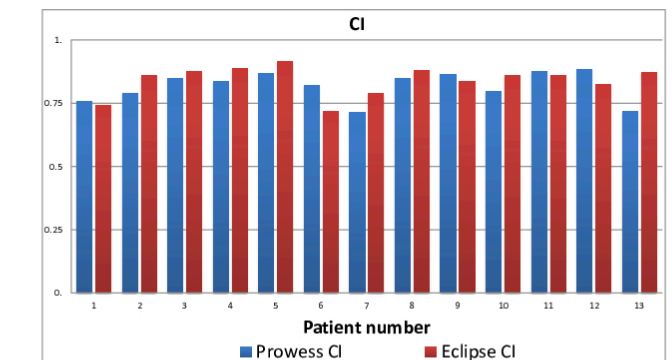

Figure 5. Comparison of conformity index (CI) for Prowess Panther and Varian Eclipse plans.

CONCLUSIONS

Our study showed that the Panther TPS produced clinically acceptable treatment plans for the new machine comparable to the previously treated Varian Eclipse plans in terms of target coverage, conformity index and OAR sparing.

REFERENCES

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