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Evaluation of RapidPlan Model Performance after an Eclipse Version Upgrade

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INTRODUCTION & AIM

- Knowledge-based treatment planning, utilizing Varian's RapidPlan within the Eclipse treatment planning system, improves radiotherapy planning efficiency and inter-panner consistency [1].
- Clinical institutions routinely undergo major Eclipse version upgrades, which modify underlying plan optimization engines and dose calculation algorithms. However, such modifications can introduce systematic shifts in calculated dose distributions, potentially degrading the accuracy of existing RapidPlan models.
- The aim of this study is to evaluate the performance of a RapidPlan model develop in Eclipse v15 following an Eclipse version upgrade to v18.

METHODS AND MATERIALS

- Five-fraction lung stereotactic body radiation therapy (SBRT) RapidPlan model
  - 2-3 volumetric modulated arc therapy (VMAT) coplanar arcs
  - Developed in Eclipse v15
- A retrospective study was performed on N = 15 lung cancer cases treated between 2023 and 2025
  - Prescription dose: 50 Gy or 55 Gy or 60 Gy in 5 fractions
  - Volume of planning target volume (PTV): ranged from 5.4 cc to 70.3 cc
- Plan generated by the RapidPlan model in Eclipse v15 was compared to that generated in Eclipse v18
  - Same VMAT arc geometries and model parameters
  - No manual intervention to the plan optimization other than normalizing prescription dose to cover 95% of PTV
- Statistical analysis: Wilcoxon signed-rank test
  - Plan quality evaluation metrics
    - Applicable clinical objectives, as defined in RTOG0813 and AAPM TG101 [2]
    - Total MU
    - Maximum dose (Dmax)
    - Maximum dose 2 cm away from the PTV (D2cm)
    - Lungs V20Gy
    - Conformality index
    - Gradient measure as reported in Eclipse

RESULTS

- For applicable clinical objectives, the plans generated in Eclipse v18 demonstrated the same pass rates as those generated in Eclipse v15 across all cases.
- No statistically significant differences in the medians of the remaining metrics were observed at the 1% significance level, except for Dmax (Median v15: 128.6%; v18: 124.7%).
- Table 1 summarizes the comparison of plans generated by RapidPlan model in Eclipse v15 and Eclipse v18 for all lung SBRT cases. Compared to Eclipse v15, plans in Eclipse v18 show statistically significant lower Dmax ($p<0.001$) while other quality metrics are similar. The observed difference in Dmax is not considered clinically relevant.

Table 1. Summary statistics for lung SBRT plans generated by RapidPlan model in Eclipse v15 and Eclipse v18. For each plan quality metric, the median, interquartile range (in parentheses) and Wilcoxon signed-rank test p-value are reported. Dmax, D2cm and lungs V20Gy are reported as percentages of the prescription dose.

Plan quality metrics	Eclipse v15	Eclipse v18	Wilcoxon signed-rank test p-value
Total MU	3784.6 (3313.3-3912.3)	3271.4 (3000.0-3746.0)	0.064
Dmax (maximum dose)	128.6% (125.1%-130.1%)	124.7% (122.5%-127.3%)	<0.001
D2cm (maximum dose 2cm away from target)	51.4% (49.6%-55.3%)	49.5% (46.5%-53.7%)	0.139
Lungs V20Gy	4.4% (2.4%-8.2%)	4.4% (2.5%-8.3%)	0.045
Conformity index	0.98 (0.97-1.00)	0.97 (0.96-0.99)	0.187
Gradient measure [cm]	1.08 (0.91-1.18)	1.09 (0.89-1.19)	0.131

DISCUSSION

- Creating and implementing a RapidPlan model requires substantial effort, including:
  - Selection of high-quality training plans
  - Model training
  - Extensive model validation with clinical data
- This study demonstrates that a lung SBRT RapidPlan model developed in Eclipse v15 produces plans of comparable quality after Eclipse v18 upgrade.
- Eliminating the model re-building/validation process after a treatment plan system upgrade significantly reduces the resource burden for busy radiation oncology clinics.

CONCLUSIONS

- After Eclipse v18 upgrade, the five-fraction lung SBRT RapidPlan model produced plans of comparable quality to those generated in Eclipse v15.
- The statistically significant difference observed in Dmax does not translate to a meaningful clinical impact.
- These results suggest that RapidPlan models developed in a previous Eclipse version can be effectively reused to provide a viable starting point for plan optimization after an Eclipse version upgrade.

REFERENCES

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