

An Automated Treatment Planning Platform for VMAT-Based Total Body Irradiation

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Purpose

To streamline the treatment planning and delivery workflow for VMAT-based Total Body Irradiation (TBI) and evaluate its impact on utilization of clinical resources.

Methods

VMAT-based TBI treatment planning is a clinically resource-intensive process that can limit treatment availability for many patients. To address this issue, an in-house software platform was developed to automate and standardize key components of the VMAT TBI workflow. The software features a template-driven interface designed to minimize user interaction and improve planning efficiency. Using the Varian Eclipse API, the system automatically generates treatment courses, processes structures, performs iterative plan optimization, and prepares plans for delivery. The software incorporates advanced image-processing algorithms to determine isocenter locations, configure beam geometry, and evaluate dose inhomogeneities and junction gradients following optimization. To benchmark performance, we compared clinical resource requirements, hot-spot characteristics, and dose inhomogeneity metrics against previously published VMAT TBI results.

Results

The average planner time required to generate a clinically acceptable VMAT TBI plan was reduced to under 5 minutes, supplemented by ~60 minutes of automated background optimization and dose calculation; for up to 12 treatment plans using Eclipse v18 with GPU support. The system maintained dosimetric consistency with published dosimetric constraints of PTV D2cc, D95%, and V120%. In addition, an acceptable mean dose for lungs, brain, and kidneys were achieved. Analysis of inter-plan junction dose gradients in the superior–inferior direction showed that 95% of sampled gradients remained within the predefined value of 2% of prescription dose per mm, enabling robust dose summation despite potential setup uncertainties during delivery.

Conclusion

The automated VMAT TBI planning platform substantially reduces the clinical resources required to generate high-quality treatment plans. The integrated database for storing patient-specific optimization parameters enhances standardization and workflow reproducibility. Additionally, the built-in junction-evaluation tools provide comprehensive assessment of gradient regions near critical organs, supporting safer and efficient clinical implementation.