

Dosimetric and LET_d Evaluation of the Horizontal Port System Compared to Rotating Gantry-Based Carbon Ion Radiation Therapy in Early-Stage NSCLC

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Aims

- This study evaluates the feasibility of a horizontal port (HP) system for carbon ion radiation therapy (CIRT) in early-stage non-small cell lung cancer (NSCLC) by comparing relative biological effectiveness (RBE)-weighted dose and dose-averaged linear energy transfer (LET_d) with gantry plan.

Subjects and Methods

- Cases: Three NSCLC patients
- Prescription dose: 60 Gy(RBE) / 4fx
- Beam angles: Listed in Table 1
- Robust optimization: ±3 mm and ±3.5% uncertainties
- Evaluation: Dose and LET_d statistics
- Dose calculation algorithm: Pencil beam

Table 1. Beam angle information for each patient.

Patient	Port	Gantry angle / Yaw / Roll (°)	
		Gantry Plan	HP plan
A & B	1	330 / 0 / 0	75 / 30 / 0
	2	0 / 0 / 0	75 / 330 / 0
	3	30 / 0 / 0	105 / 30 / 0
	4	60 / 0 / 0	105 / 330 / 0
C	1	270 / 0 / 0	255 / 30 / 0
	2	300 / 0 / 0	255 / 330 / 0
	3	330 / 0 / 0	285 / 30 / 0
	4	30 / 0 / 0	285 / 330 / 0

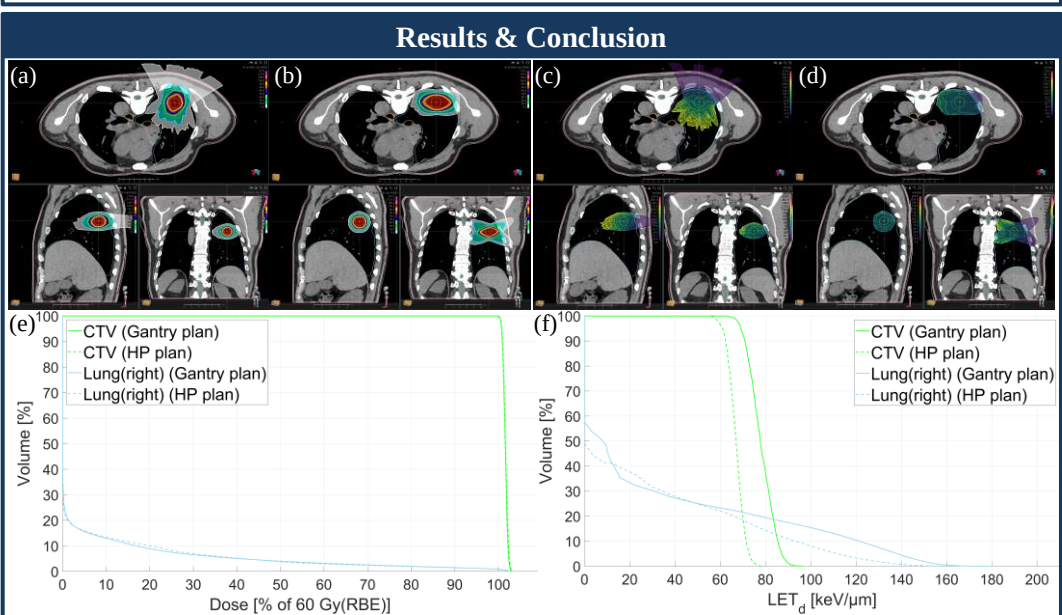


Figure 1. Dose and LET_d distributions of the Gantry plan (a and c) and the HP plan (b and d) for representative Patient A. Mean dose–volume histogram (DVH) and mean LET_d–volume histogram (LVH) over three patients are shown in (e) and (f), respectively.

- The mean DVHs of the CTV and right lung were comparable between the Gantry and HP plans. The LVH values in the right lung tended to be lower in the HP plan than in the Gantry plan, whereas the minimum LET_d within the CTV was higher in the Gantry plan than in the HP plan.
- The gantry system may provide greater clinical reliability, considering clinical factors such as setup stability, organ motion, and reproducibility.