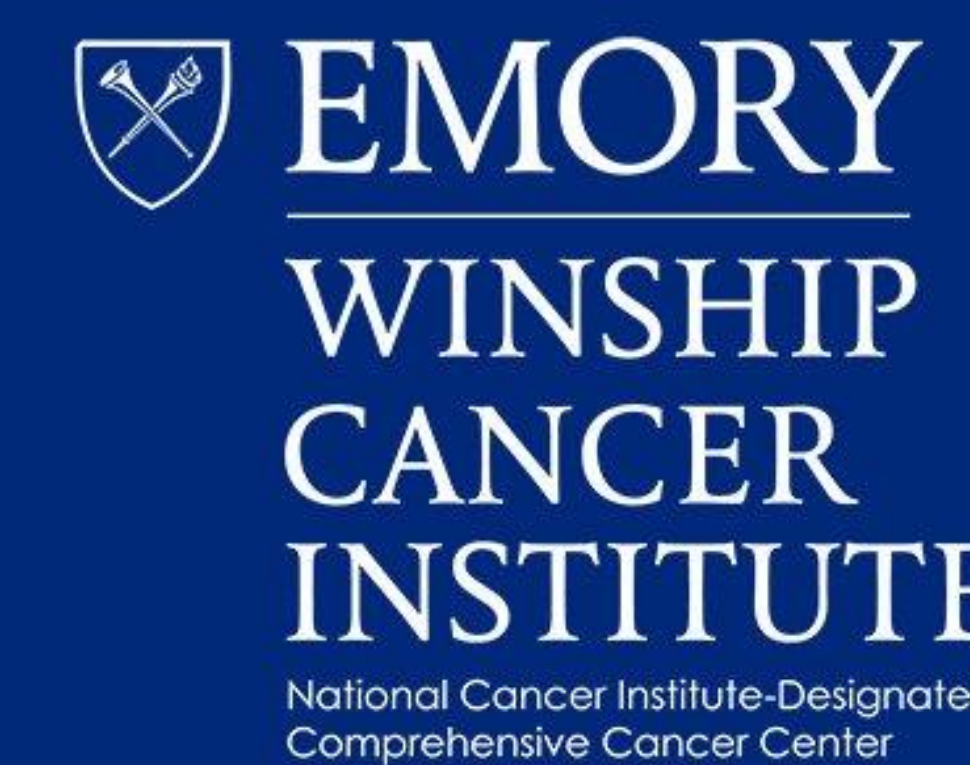




Lung SBRT: Size-specific optimization of the dose gradient

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INTRODUCTION

Purpose: To investigate optimization settings that steepen the dose gradient as a function of target size for lung stereotactic body radiation therapy (SBRT).

NTO: A spatially varying one dimensional constraint in the optimization workspace that can help improve the compactness of the isodose distribution by penalizing progressively lower isodose lines as distance increases from the target.

- Manual NTO: The user can modify the dose gradient outside of the target

METHODS

- 68 previously treated lung SBRT cases were replanned to 50 Gy using a static NTO and a dynamic NTO in the Eclipse™ treatment planning software (Version 16.1.0)
- Cases were categorized into 3 groups: small (<20 cc), medium (20-50 cc) and large (>50 cc)
- All plans were calculated on a Varian Edge using 6X-FFF and a 1400 MU/min dose rate
- Acuros (Version 16.1.0) was used for the final dose calculation
- Plans were generated using various fall-off values (0.1, 0.2, 0.3, 0.4, 0.5 mm⁻¹)

Dynamic NTO: Optimization was performed without user intervention

- One lower of 100% was placed around 52 Gy with priorities of 100
- The NTO priority settings were as follows: 100% dose at 0 cm from the target border, 20% end dose, and a priority of 150
- NTO fall-off values were investigated
- All plans were normalized such that the prescription dose covers 95% of the target volume

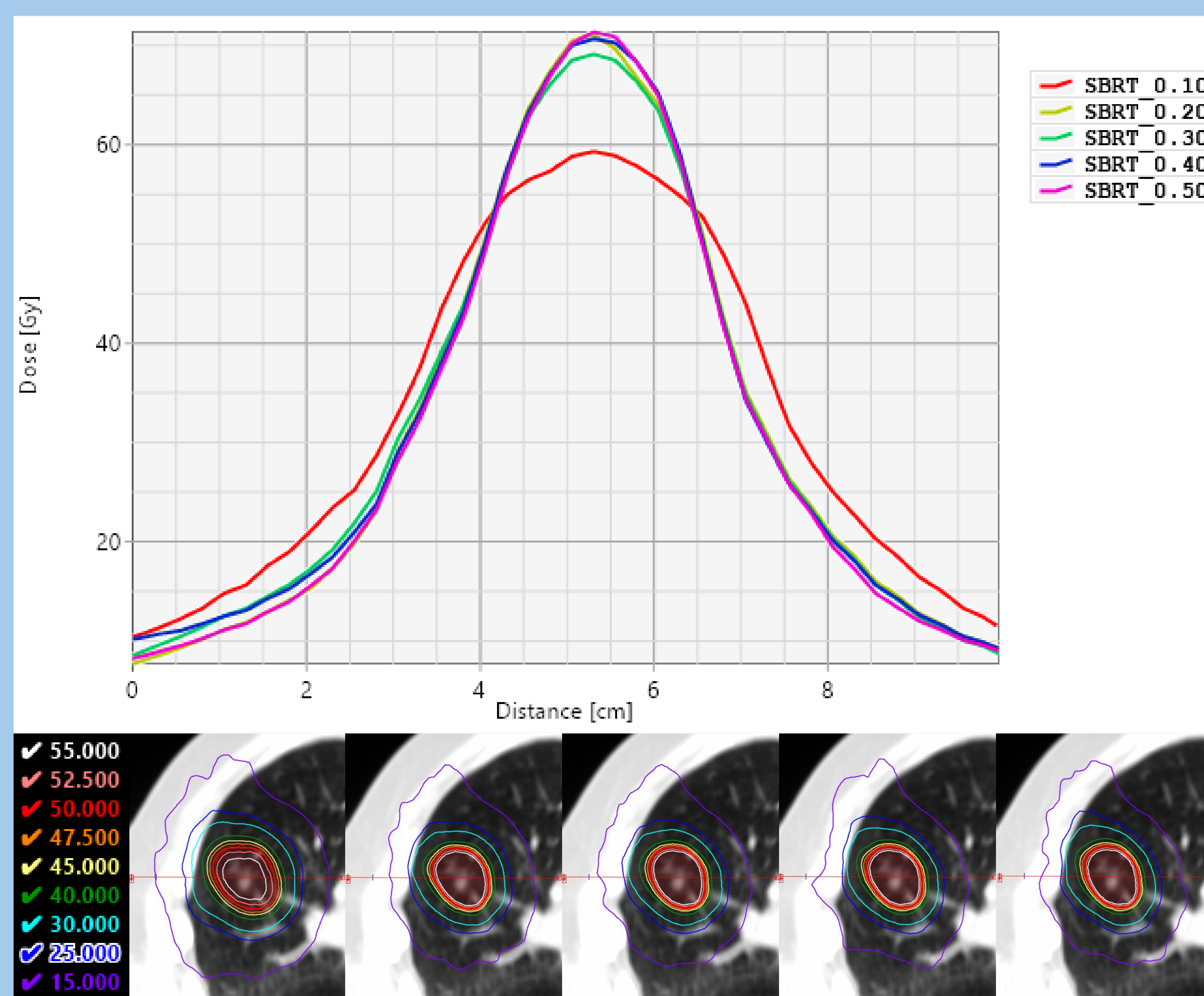


Fig 1. Dose profile and isodose distributions for a small case (14.8 cc).

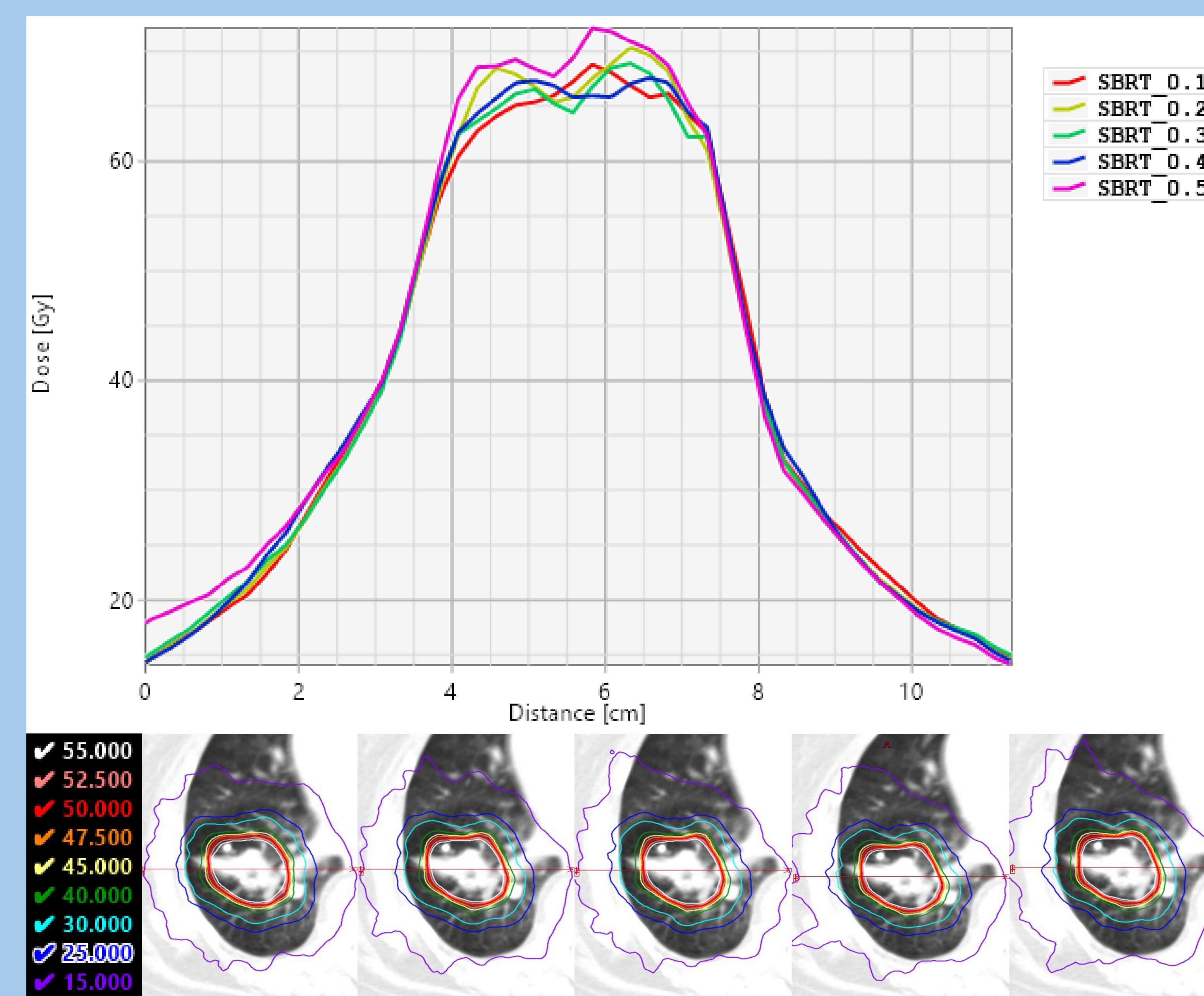


Fig 2. Dose profile and isodose distributions for a large case (59.6 cc).

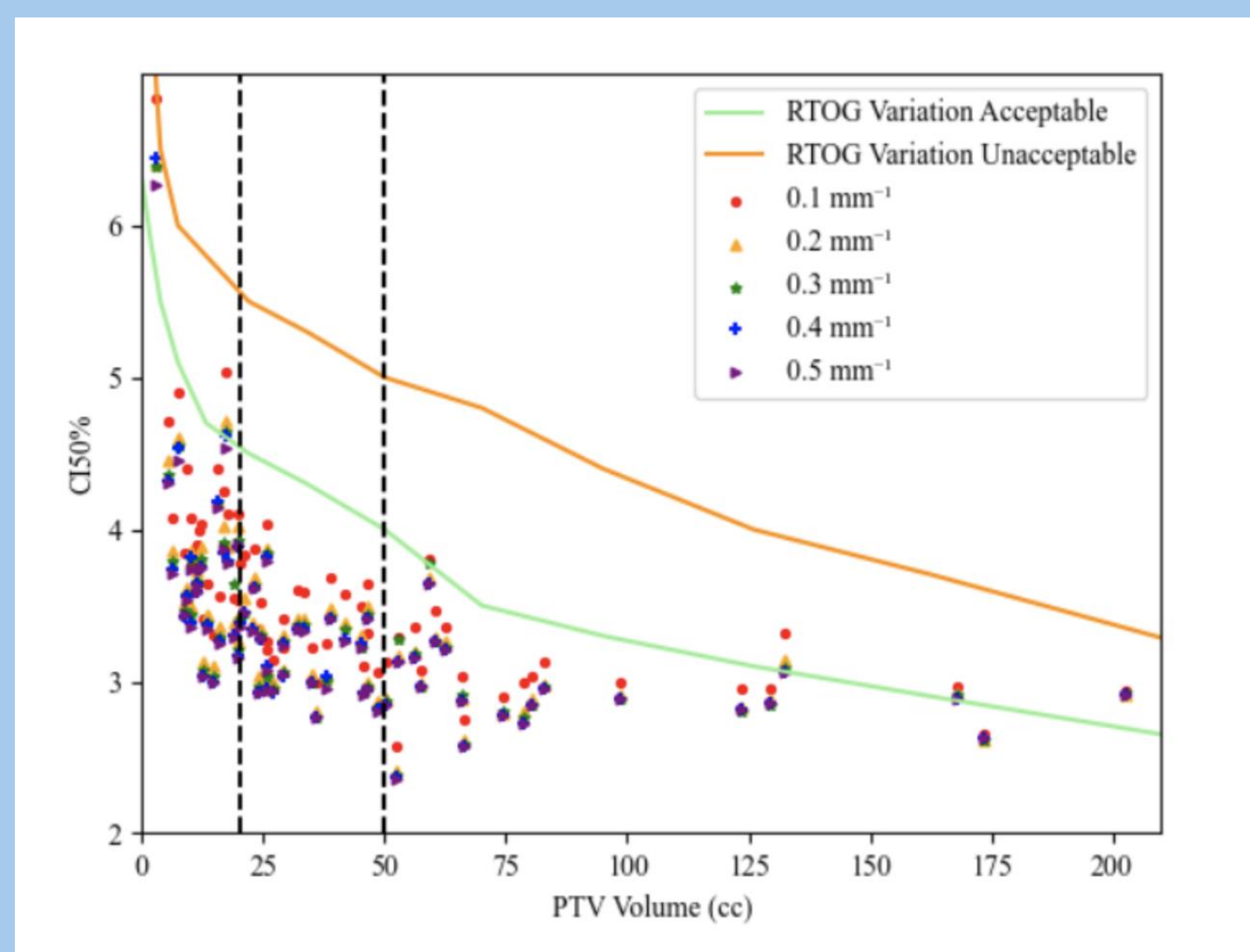


Fig. 3. The fall-off groups (0.1-0.5) are plotted against the RTOG 0813 variation acceptable and unacceptable criteria. The vertical dashed lines represent the division of the target's sizes: small (<20 cc), and large (>50 cc).

	0.1 mm ⁻¹	0.2 mm ⁻¹	0.3 mm ⁻¹	0.4 mm ⁻¹	0.5 mm ⁻¹
MU	3545±44	3977±557	4118±572	4241±619	4325±675
Dmax (Gy)	64.1±3.8	64.5±3.3	66.5±3.5	67.1±3.5	68.1±3.6

Table 1. Average and standard deviation for all cases (n=68).

	0.1 mm ⁻¹	0.2 mm ⁻¹	0.3 mm ⁻¹	0.4 mm ⁻¹	0.5 mm ⁻¹
Small	4.41	3.89	3.84	3.80	3.78
Medium	3.45	3.25	3.21	3.19	3.18
Large	3.08	2.96	2.95	2.92	2.92

Table 2. Average CI50% for small, medium and large groups (n=68). CI50% = 50% isodose line / Target volume

RESULTS

- Average CI50% value decreased with increasing NTO fall-off values for small and medium groups
 - In the small group, statistically significant differences were found between the 0.1 mm⁻¹ fall-off group and 0.3-0.5 mm⁻¹ fall-off groups
 - In the medium group, statistically significant differences were found in the 0.1 mm⁻¹ fall-off group, and the 0.2-0.5 mm⁻¹ fall-off groups
- Significant increase in MUs across all target sizes as fall-off values increased
- D_{max} increased as fall-off values increased
- All plans 68 plans generated CI100% and CI50% were within the RTOG 0813 recommended guidelines

CONCLUSIONS

This study characterizes dose conformity across a wide range of PTV sizes and different fall-off parameters of the manual NTO setting for lung SBRT cases while using a straightforward planning approach. As target size increases, the importance of fall-off values in achieving an acceptable CI50% diminishes. Smaller targets benefit from higher fall-off values despite increased D_{max} and MUs. Consideration of fall-off value relative to target size is crucial to limit dose spillage outside the target.

REFERENCES

