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Conference Poster

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ITV or tumour tracking for dose painting of NSCLC?
A comparison of target coverage and out-of-target dose in proton treatments

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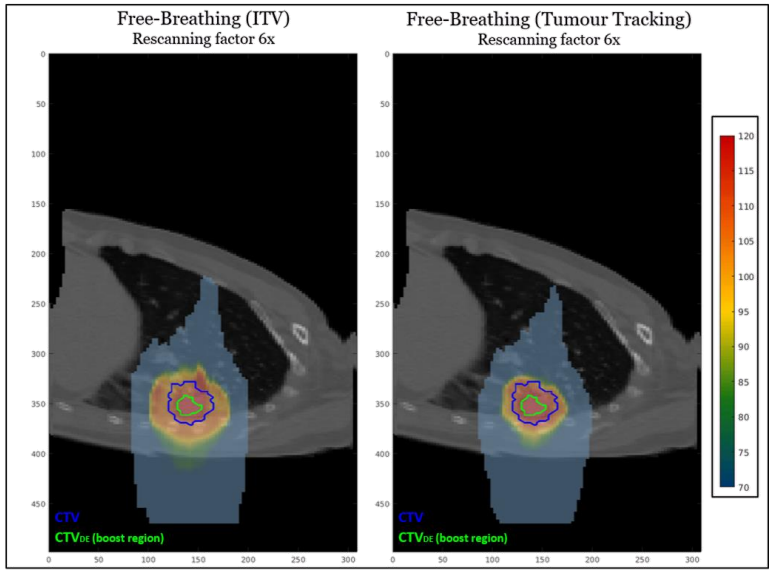
Introduction

Dose painting of a non-uniform dose distribution is challenging in the presence of organ motion, especially when it comes to proton therapy delivered with pencil beam scanning. We performed a comparative planning study to assess the potential of tumour tracking (TT) against the standard clinical approach based on the definition of an internal target volume (ITV).

Methods

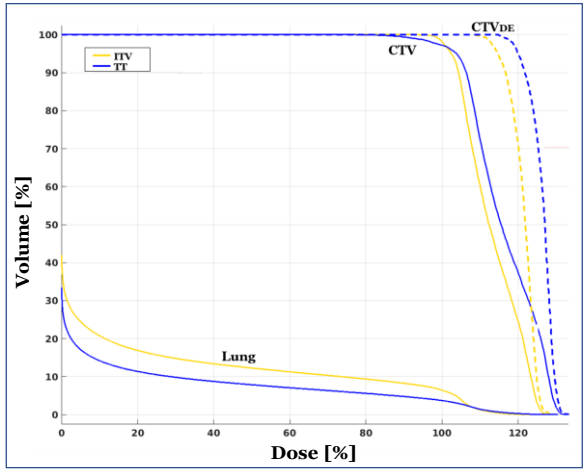
A single fraction treatment (2GyRBE) has been simulated for an advanced-stage NSCLC patient including a dose escalation (DE) by 17% of the clinical prescription to a region within the CTV with high-SUV on pre-treatment HX4-PET images (CTV_{DE}). The free breathing tumour motion was evaluated on planning 4D-CT images to define an ITV as the union of CTVs in all breathing phases, covering 7mm target displacement. An additional 10mm isotropic expansion has been applied to obtain the PTV. The TT plan was optimised on a single-phase CTV using uniform 5mm planning margin. Both treatments were simulated for an increasing number of rescanning, up to 6 times and tumour tracking was based on the energy-sorted method introduced by Fattori et al[1].



Results

Target coverage (V95) for CTV and CTV_{DE}, treated volume (TV, isodose 95%) and the out-of-target hot spot volume (HS, dose > 100% of prescription) were calculated following the ICRU-50 definitions.

While coverage was consistently higher than 98% for both targets in all scenarios, a marked reduction of the treated volume was allowed by planning with reduced margins for tumour tracking. In these data sets, TV_{TT} was at least 75% less than the corresponding TV_{ITV}, with negligible out-of-target dose volume (max HS 1.5cm^3) compared to HS>50cm^3 observed in ITV-based simulations.



	CTV				CTVDE	
	D95 [%]	V95 [%]	HS [cm^3]	TV [cm^3]	CI*	D95 [%]
TT	103.8	98.7	0.86	129.0	1.4	119.9
ITV	102.4	99.7	58.4	229.0	1.7	114.7

*Conformity Index

Conclusion

Current treatment protocols based on ITV allow for dose painting even in the presence of organ motion. However, should the normal tissue dose be of concern, advanced techniques like tumour tracking, have the potential to substantially reduce the out-of-target dose and burden to organs-at-risk.

Acknowledgements

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References

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