



Small fields dose calculation algorithms in the presence of lung inhomogeneity

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Introduction and Motivation

In radiotherapy, dose calculation algorithms are used to calculate dose distribution in human body. Different algorithms are used by several treatment planning and differ in the accuracy of dose calculation.

In this study, a dose calculation accuracy of two commercial treatment planning systems (TPS) were evaluated regarding Monte Carlo method.

Materials/Methods and Results

The Linac head of Primus Siemens was modeled using MCNPX Monte Carlo code based on manufacturer information. Four analytic dose calculation algorithms including PBC, AAA from Eclipse TPS, convolution and superposition from XiO treatment planning system were evaluated for a small solid tumor in lung. A solid tumor with diameter of 1.8 cm was considered in a thorax phantom and calculations was performed for 1×1, 2×2, 3×3, 4×4 cm² field sizes for 6 MV and 18 MV energies. The results of TPSs were compared with the results of MC method as a most reliable method.

A dose overestimation of up to 110% inside lung region and 25% for tumor was found for field size of 1×1 cm² in the 18 MV photon beam for PBC and convolution methods, comparing to MC results. For AAA and superposition, a close agreement was seen with Monte Carlo simulation in all studied field sizes.

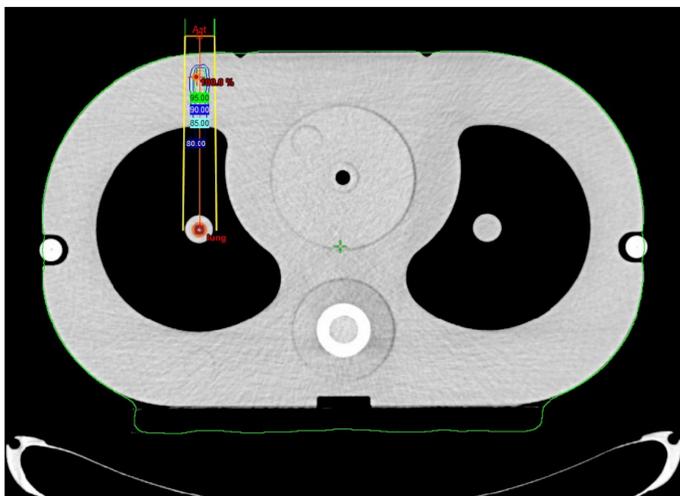


Fig. 1. CT image of the phantom and dose distribution

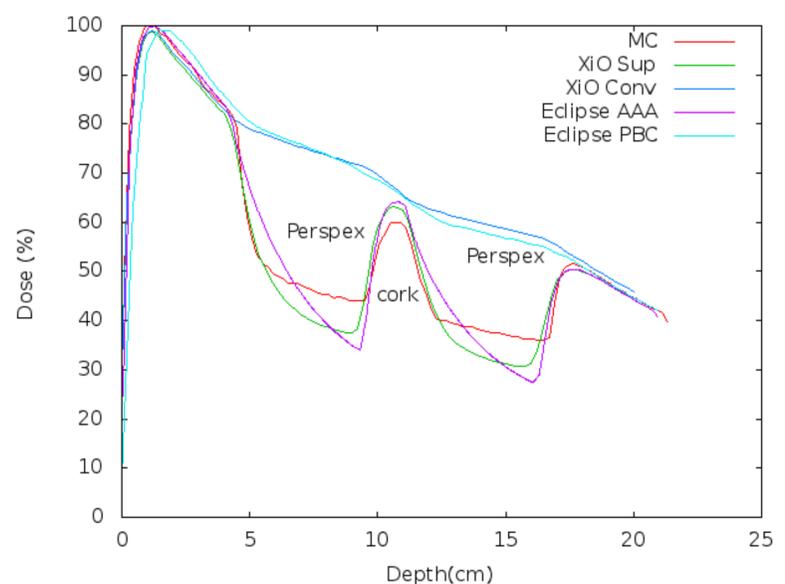


Fig. 2. Percent depth dose for different dose calculation algorithms

Our results showed that the PBC and convolution methods overestimate the lung dose as well as the solid tumor dose significantly and large errors could arise in treatment plans of lung region and change the outcome of treatment.

Conclusion

The Use of MC based methods, AAA and superposition methods are recommended for lung treatments with small fields.

References

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