An Extensive Evaluation of the Monte Carlo Treatment Planning for Stereotactic Radiosurgery

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ABSTRACT

The accuracy of conventional empirical and semi-empirical dose calculation algorithms for radiation therapy treatment planning is limited. The main problem is that these algorithms fail to adequately consider the lateral transport of radiation. Most conventional algorithms use measured dose distribution data as input. These data induce an added inaccuracy to stereotactic radiosurgery dose calculations due to the difficulty of acquiring accurate dosimetric data for very small beams. However, since multiple arcs of large solid angles are usually used in stereotactic radiosurgery, the errors introduced by conventional dose algorithms are quite likely to be diluted. In the present work, the use of Monte Carlo treatment planning for the linac based stereotactic radiosurgery has been investigated. The OMEGA Monte Carlo code system is used as the dose engine in an in-house developed radiosurgery treatment planning system. The Monte Carlo treatment plans are done for ten typical clinical cases. The results are presented in the form of dose-volume histograms as well as 2D and 3D isodose distributions combined with image data. The Monte Carlo plans are compared with the plans which are calculated with a conventional dose algorithm based on standard TMR/OAR formalism. The difference between these two planning methods is analyzed.