AbstractID: 4826 Title: Effect of Voxel Size on Monte Carlo Dose Calculation for Intensity Modulated Radiotherapy Treatment Planning

Purpose:

In radiotherapy treatment planning, the voxel size plays a role in each step, from the structure contouring, beamlet calculation, treatment optimization to plan analysis. Large voxels may affect the planning accuracy while small voxels will increase computation time significantly. The choice of voxel size is a compromise between planning accuracy and computation speed. This work investigates the effect of voxel size on the accuracy and computational speed of Monte Carlo based treatment planning for IMRT.

Method and Materials:

Selected patients with various treatment sites were scanned on a CT simulator and the CT data with RT structures were converted to patient geometry files with different voxel sizes for Monte Carlo simulations. Comparisons of the structure volume, beamlet dose distribution, plan optimization, DVHs and dose distributions were made with different voxel sizes. Target and critical structures with small volumes, such as the optical nerves in head and neck cases, were specially considered in the comparison.

Results:

In Monte Carlo IMRT planning, differences in the open-field dose calculations prior to the optimization process using different voxel sizes (4 x 4 mm^2 and 2 x 2 mm^2) were usually small. However, the results from the optimization showed that different voxel sizes could generate different beamlet weights resulting in different treatment plans. The effects could be clinically significant. For the same IMRT plans, the effects of voxel sizes in the dose and DVH calculations vary depending on the treatment sites, anatomy and target/organ volume. Small voxel sizes (1-2mm) are necessary for small structures in and near heterogeneous geometries such as in the head and neck regions.

Conclusions:

The effect of voxel size on dose calculation and plan optimization can be clinically significant in IMRT treatment planning. Small voxel (1-2mm) should be used for head and neck cases.