AbstractID: 9051 Title: Construction of a surface-based 3D human model and Monte Carlo dose calculations

Purpose: To construct a surface-based 3D human model for Monte Carlo dose calculations and compare the model with the conventional voxel-based model, in terms of computation speed and calculation accuracy. **Method and Materials:** A voxel-based 3D human model was converted to a surface-based model (a polygon model) with 3D-DOCTOR^{TM}. The model was then refined with 'Remesh' and 'Smooth' functions of Rapidform®2006. The volumes of the organs and tissues were adjusted to the original values with 'Polygon Offset' function. Finally, the developed surface model was used, in conjunction with Geant4, to calculate organ radiation doses and the results were compared with those of the voxel model, in terms of computation speed and calculation accuracy. **Results:** The results show that the surface model is much slower in particle transport or dose calculation than the voxel model. The difference of computation speed was much more than several times, depending on the size of polygons and voxels. The error of the surface model in dose calculation was negligible (i.e., << a few %), as long as the polygon size was not very large (i.e., < 0.5 cm^2 on the average). The results also show that the calculation speed of the surface model rapidly increases with the average size of the polygons. **Conclusion:** The surface model has several advantages over the conventional voxel model. The organs and tissues in the surface model can be easily moved or deformed, which is advantageous for 4D Monte Carlo dose calculations. The surface model is also suitable for accurate modeling of thin structures such as skin, oral mucosa, etc. This work, however, indicates that the computation speed of the surface model is significantly slower than the conventional voxel model. This problem can be addressed by optimizing the particle transport algorithm to polygon surfaces.