AbstractID: 8291 Title: Variability of low-Z Inhomogeneity Correction in IMRT/SBRT: A Multi-Institutional Collaborative Study

Purpose: The dosimetry of IMRT beamlets with low-Z inhomogeneities is a difficult problem and its accuracy is highly uncertain due to lateral disequilibrium. Various inhomogeneity correction algorithms: pencil beam (PB), collapsed cone convolution (CC), anisotropic analytical algorithm (AAA), Monte Carlo (MC), and combination of them are employed in different treatment planning systems (TPS) for dose calculations. This multi-center collaborative study evaluates the accuracy and suitability of these algorithms for inhomogeneity correction in clinical trails.

Method and Materials: A simple lung phantom was constructed with cork sheets (0.25 g/cm^3) sandwiched between two 3 cm thick solid water slabs. The CT data of this phantom was sent to 8 institutions employing different TPS. Dose calculations were carried out at various depths over the field sizes: 0.5x0.5-10x10 cm^2 for 6 and 15 MV beams with grid size (2x2 mm^2). The calculated inhomogeneity correction factor (CF) was compared with measured data using a micro-chamber.

Results: The calculated CF with various algorithms showed marked variability and can be categorized in two classes; pencil beam (PB) and MC based collapsed cone (CC). The CF calculated with PB rises steadily in the lung tissue whereas CC exhibits the effect of electron transport. The differences between measured and calculated CF values varied from 70% to -10% for 6 MV from small to large fields. For 15 MV beam, the differences are even larger for small fields but reduce significantly for large field sizes (>5x5cm^2).

Conclusion: It is concluded that PB based algorithms should be avoided for dose calculation in small fields with low-Z inhomogeneities. The MC derived kernel based algorithms such as CC and AAA produce similar results to each other within ±10% and should be preferred for patient treatment in IMRT/SBRT. This study raises serious concerns in dosimetric variability in lung cancers possibly impacting the clinical trials.