AbstractID: 3945 Title: Effect of tissue inhomogeneitis on MU required to deliver prescribed dose - Monte Carlo study

Purpose:
The purpose of this study is to evaluate the effect of tissue inhomogeneities and surface irregularities on the value of monitor units, MU, calculated for radiotherapy treatments with electron beams of various anatomical sites.
Method and Materials:
The Monte Carlo software used is the commercial implementation of VMC++ (Nucletron). For each CT based patient anatomy three types of calculations are performed: with inhomogeneity and surface corrections, with surface correction only (no inhomogeneity correction), and water tank geometry (no inhomogeneity or surface corrections). The Monte Carlo software was set to calculate dose to medium. The 0.49 cm^3 calculation voxels had an overall statistical uncertainty of about 1.5%.
Results:
Dose distributions for 20 breast and 20 head and neck patients were analyzed. The electron beam energy was chosen so that the treatment target was encompassed by the 90% isodose when both inhomogeneity and surface corrections were applied. The dose prescription point was typically selected on the 90% isodose or at d_{max}. For breast cases MU calculated with both corrections differed by up to 7% compared to the water tank geometry. When the target was close to the lung more MU were needed to deliver the prescribed dose when inhomogeneity correction was included. This is due to the decrease in scatter contribution from the lung to the target volume. In head and neck, the largest observed difference between the Monte Carlo based MU on the true patient anatomy and water tank reached 15% for the anterior nose treatment.
Conclusion:
Prescribing electron treatments using MUs based on patient anatomy leads to delivery of the true prescribed dose. Prescriptions based on water tank geometry may lead to under-dosing of up to 15%. Retrospective and prospective studies are needed to evaluate the impact of MUs based on real patient anatomy on treatment outcomes.