AbstractID: 6659 Title: The uncertainty of dose measured with an ionization chamber in low-density media

Purpose:
An ionization chamber is often used for measuring dose distributions to validate a photon beam dose calculation algorithm for radiation treatment planning. The presence of an ionization chamber can cause dose perturbations at the point of interest especially in low-density media. This study investigates the magnitude of this type of perturbation as a function of photon beam energy and field size in a low-density lung medium.

Method and Materials:
The Monte Carlo codes BEAMnrc/DOSXYZnrc are used to simulate 6-18 MV photon beams and to calculate dose distributions in a heterogeneous phantom. We benchmarked Monte Carlo dose calculations against measurements in a lung phantom using a MOSFET detector. The dose to a point of interest in a lung medium is calculated with and without an ionization chamber in order to study the perturbation due to the chamber. The Monte Carlo simulation is also used to validate the Varian Eclipse Anisotropic Analytical Algorithm (AAA).

Results:
The results show dose increases of up to 6% and 12% due to the presence of an RK ionization chamber at the point of measurement inside lung medium for a small 3x3 cm^2 field for 6 and 18 MV incident phantom beams, respectively. However this dose perturbation becomes negligible when beam field size increases to 10x10 cm^2. The results of Monte Carlo calculation show that AAA is accurate in predicting dose distributions in lung and at lung-tissue interface for 6 MV beam. This result contradicts the conclusion by Van Esch et al (Med. Phys. vol.33, pp.4130-48, 2006). Our finding of chamber perturbations explains the discrepancies between their measurements and calculations using AAA.

Conclusion:
Ionization chambers are not suitable for measuring dose in low-density medium due to perturbation.