Small field dosimetry in non-homogeneous phantom

Purpose: Small fields has been used in radiotherapy due to development of new technology in tomotherapy, radiosurgery (SRS), intensity modulated radiotherapy (IMRT), Gamma Knife, and Cyber Knife. We study the dosimetry of small fields like output factor, profiles in homogenous and non-homogeneous phantom.

Material and Methods: Field sizes of 0.8, 1.6, 2.4, 3.2, 4.8 and 9.6 cm square (defined at isocenter level) were used for this experiment from Elekta Synergy accelerator (Elekta, Crawley, UK). Two phantoms were used in this study: polystyrene (Polystyrol 495F, BASF, Germany) 30 x 30 x 20 cm^3 phantom of 1-cm thick slabs and a sandwiched (non-homogeneous) lung equivalent phantom, which is further described. The sandwiched phantom is a combination of nine polystyrene slabs (1-cm thick each) of density 1.02 ± 0.02 g/cm^3 positioned above and below two slabs (1.2-cm thick each) of lung equivalent density 0.3 ± 0.02g/cm^3. EBT film (International Specialty Products, NJ, USA) has been applied in this study and results were compared with diamond detector (Type 60003-9-0002 – PTW-Freiburg).

Results: A 4.3% and 1.1%output difference was measured in homogeneous polystyrene phantom between EBT film and diamond measurement at 0.8cm and 1.6cm square field sizes respectively for 6 MV. This value is 2.4% and 1.4% in higher photon energy of 18 MV because lateral range of electrons is the critical parameter that influences the charge particle equilibrium rather than forward range of the electrons. Due to electronic disequilibrium, this value is high (33.6%) in non-homogeneous phantom. The profile showed that 18MV has lower response for small field than 6MV photon beam in both phantom materials.

Conclusion: EBT film can be used for output factor measurements and relative dosimetry for small fields. This uncertainty in non homogeneous medium between two detectors has activated us to continue this study.