DOSE PERTURBATION NEAR AIR-WATER INTERFACES: A POTENTIAL CLINICAL APPLICATION

The purpose of this work is to study the dose perturbation near air-water interfaces, and to explore its potential clinical application to reduce dose to rectal mucosa during external beam treatment of prostate cancers. EGS4 Monte Carlo was used to calculate the perturbations on beam spectra produced by air cavities and effects of photon-beam quality, size and position of air cavity, and the air pressure in cavity. Three types of cavity shapes (planar slab, disk and cylinder) were studied. Significant perturbation on both photon and electron fluence was observed due to the presence of the air cavity. The calculations show that the dose perturbation near the interface depends on energy of photon beam, size and location of air cavity and field size. The dose reduction near interface increases with the energy of photon beam and cavity size, and can be as high as 35%. The EGS4 results were compared with the published data for an air slab. A general agreement was observed except very near the interface. A potential clinical application of dose reduction near a tissue-air interface is proposed to reduce the rectal mucosal dose if patient rectum is ballooned up during the external beam treatment of prostate cancer. For example, the dose reduction at 0.1 and 0.5 mm away from the interface in the forward region are 20% and 10%, respectively, for a 15 MV photon beam. Further pathological and clinical study is required to utilize this approach.