AbstractID: 10304 Title: Dosimetric effect of a small air cavity for clinical electron beams: A Monte Carlo study

Purpose: This study investigated dosimetric changes in a water phantom when a small air cavity was presented at the central axis of a clinical electron beam. 6, 9 and 16 MeV electron beams with a 10×10 cm^2 applicator and cutout produced by a Varian 21EX linear accelerator were used.
Methods and Materials: Percentage depth doses (PDDs) for different depths (0.5–7 cm), thicknesses (2–10 mm) and widths (1–5 cm) of air cavities were calculated using Monte Carlo simulations (EGSnrc code) validated by film measurements.
Results: When the depth or thickness of the air cavity was changed, the PDD below the cavity was shifted with a distance equal to the thickness of cavity. However, when the width of the air cavity was changed, both the PDD and its slope within and below the cavity were changed. A larger width of the air cavity resulted in a shallower PDD within the cavity. The dependence of the depth dose on the width of the air cavity is due to the contribution of the electron side-scattering in the water surrounding the cavity. Neglecting an air cavity of 1 cm thickness in the build up region of a 6 MeV electron beam resulted in a delivered dose 10%–12% larger than the original prescription. Delivered doses 3% and 6% higher than the prescribed dose were observed when doses were prescribed at R_{80} for a 16 MeV electron beam. These results were obtained by neglecting air cavities with thicknesses equal to 2 and 4 mm at a depth of 5 cm, respectively.
Conclusions: The dosimetry data in this study can help radiotherapy staff estimate and predict the deviation between the prescribed and delivered dose, when inevitablely neglecting the small air cavity or inhomogeneous correction in the dose calculation and output measurement.