AbstractID: 2713 Title: Electron beam treatment verification using measured and Monte Carlo predicted portal images

Purpose: In this study, we propose to use the bremsstrahlung part of the electron beam to produce portal images during electron beam treatments. We also investigate the possibility of using Monte Carlo (MC) simulations to predict the electron beam portal images and to use these predicted images to verify electron beam treatment delivery.

Method and Materials: The Varian CL21EX linear accelerator and the aS500 Varian electronic portal imaging device (EPID) were used to acquire all images. The images were obtained for various electron energies (6 to 16 MeV) and cut-out sizes; a 10.7 MU dose was delivered during the acquisition. A portal imaging quality assurance phantom (QC-3V) was used to calculate the contrast, the resolution and the modulation transfer function (MTF) of the images. Images were also acquired using Rando, an anthropomorphic phantom. EGSnrc was used to build a MC model of the Varian CL21EX and of the aS500 EPID. MC calculations were used to characterize the bremsstrahlung photon beam and to obtain predicted images of the QC-3V and Rando phantom.

Results: The contrast and the resolution of the images obtained with the bremsstrahlung radiation are comparable to those of a 6 MV photon beam. MC simulations showed that the main sources of photons in an electron beam are the scattering foils and the applicator. It was also shown that the quantity and the quality of the bremsstrahlung beam produced have a direct impact on the image quality. The simulated and measured portal images agree within ± 8% for both the QC-3V and the Rando phantom.

Conclusion: Images with adequate contrast and resolution were obtained under various relative conditions. Portal images were predicted using MC simulations and a good agreement was obtained; this is a first step towards an electron treatment verification tool.