AbstractID: 12594 Title: Energy spectra, fluence profiles and dose distributions of the five newly available kV-CBCT beams

Purpose:
To obtain beam data of x-rays produced by an on-board imager (OBI) in the acquisition of kilovoltage cone-beam computed tomography (kV-CBCT). The determination of beam data is essential for commissioning an x-ray beam in a radiotherapy treatment planning system in order to facilitate the management of additional radiation exposure to radiotherapy patients resulting from image-guided procedures.
Method and Materials:
The Monte Carlo code, BEAMnrc, was used to simulate the x-ray tube including its x-ray defining systems and bow-tie filters. The simulated beams included five different kV-CBCT beams (Head, Low-dose Thorax, Pelvis and Pelvis Spot Light with two different Bow-tie filters) available in the recent Varian OBI 1.4 system. The Monte Carlo simulated incident beams were analyzed and calculated dose distributions from each simulated beam were benchmarked against measured dose distributions.
Results:
Using the Monte Carlo generated realistic incident beams, the calculated dose profiles agree well with the measurements within experimental uncertainties. The beam characteristics of five available kV-CBCT beams including photon fluence, average beam energy and photon spectra are obtained. The calculated dose profiles were validated with measured profiles in water. The photon fluence of kV-CBCT beams showed a strong dependence on geometry of added filters as well as x and y beam collimations. The mean photon energy near the beam central axis is 20% lower compared to that farther away from central axis due to the shape of the bow-tie filter which is thinner near the beam central axis.
Conclusion:
This study demonstrates that the Monte Carlo simulation can play an essential role in providing beam parameters which are necessary for the commissioning of a kV CBCT beam in a radiotherapy treatment planning system. The accuracy of the simulations must be validated by experimental measurements in order to ensure the subsequent accuracy of the beam data.