AbstractID: 3453 Title: Feasbility study of orthogonal bremsstrahlung beams for improved radiation therapy imaging.

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Purpose: To study the feasibility of using orthogonal bremsstrahlung beams for imaging in radiation therapy. The orthogonal bremsstrahlung is produced in linac targets in directions perpendicular to the incident electron beam.
Method and Materials: BEAMnrc MC modeling was used to design different targets and to obtain energy spectra and relative intensities of orthogonal beams as well as forward-directed beams. The reliability of the simulations was checked by comparing results with benchmark experiments. Two different targets and a collimator were designed and built. The primary electron beam from the research port of a Varian Clinac-18 accelerator impinging on Al and Pb targets was used to create orthogonal beams. For these beams diagnostic image contrast was tested by placing simple Lucite objects in the path of the beams and comparing image contrast obtained in orthogonal to forward direction.
Results: The simulations showed that a thickness of 80% of CSDA range is sufficient to completely remove electron contamination in the orthogonal direction. The intensity of the orthogonal beam for high-Z targets is larger compared to low-Z targets by a factor 20 for W compared to Be. For a 6 MeV electron beam, the average energy for low-Z targets is lower (330 keV for Al, 170 keV for Be) compared to high-Z targets (900 keV for Pb) and lower compared to the forward beam (0.56 MeV, 0.8 MeV and 1.4 MeV for Be, Al and Pb, respectively). For irradiation times of 1.2 s in electron mode the contrast of diagnostic images created with orthogonal beams from the Al target is superior to that in the forward direction.
Conclusion: Because of the lower average energy of orthogonal beams, image contrast obtained with these beams is superior. This study confirms feasibility, both in terms of intensity and image contrast, of orthogonal bremsstrahlung beams in radiation therapy.