Purpose:To investigate the performance of a modified backscatter-shielded Electronic Portal Imaging Device (BS-EPID) system and to develop a model to convert the BS-EPID images to water-equivalent dose.

Methods:Images were acquired with a modified Varian aS-1000 BS-EPID and compared to those from a comparable clinical EPID. The asymmetry of in-plane profiles was examined as a measure of how well the system reduces the effect of the support arm backscatter. A new pixel-sensitivity correction method was assessed by comparing BS-EPID images of the same fields at different detector offset positions. A model was developed to determine the water equivalent dose from images acquired with the BS-EPID. The model converts the BS-EPID image to fluence using a deconvolution kernel, then to dose in water using a convolution kernel. The model was optimized based on experimental measurements and can be applied to construct dose in water at any depth.
The validity of the model was tested using gamma analysis to compare 28 two-dimensional dose maps of IMRT fields measured with the BS-EPID at different depths to those predicted by the Eclipse TPS.

Results:The BS-EPID profiles gave reduced asymmetry (0.6% compared to 3.3%), showing that the backscatter shielding is effective. BS-EPID images were consistent with different detector offsets within 0.4% on average.
The IMRT dose maps measured with the BS-EPID gave good agreement with those predicted by the TPS, with mean values of 94.6%, 91.8%, 94.0% and 95.3% of pixels meeting the gamma criteria of 2%, 2mm at depths of 1.5, 5, 10 and 20 cm respectively.

Conclusions:The BS-EPID performs effectively in reducing the effect of the backscatter from the support arm in Varian EPIDs. The BS-EPID dosimetry system and model allows high-resolution water equivalent doses to be measured with the BS-EPID, streamlining IMRT quality assurance.

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