Abstract ID: 16860 Title: Incorporating electron contribution into kernel-based portal dose prediction for EPID-based imagers with insufficient buildup

Purpose:
To develop and validate a kernel-based portal dose image (PDI) prediction algorithm that includes upstream electron contributions for 18 MV photon beams for a Varian aS1000 used without additional buildup material.

Methods:
Mono-energetic electron energy deposition kernels calculated using EGSnrc are incorporated into a PDI prediction algorithm. Measurements and Monte Carlo simulations are performed for open fields, several 10×10 cm*cm multi-leaf collimator (MLC) gap sweeping fields and a patient field with the imager at source to imager distances of 105 cm. Measurements are made with the imager detached from the supporting arm to avoid unnecessary backscatter and without the 1.6 mm thick protective cover. The Monte Carlo configuration mimics the measurement. The fraction of EPID signal due to electrons is computed.

Results:
Predicted open-field and MLC-field PDIs agree with measurements within 1.5% except in high-gradient beam edges. Electron contributions to the EPID signal range from 1.5% to 14% for 4×4 to 25×25 cm*cm open-field PDIs and from 5.5% to 7.7% for sweeping MLC-gap widths from 5 to 50 mm. With a 2%/2mm criteria and 10% threshold, at least 97% points of the patient test field have gamma<1. Excluding the electron contribution yields 81% of points with gamma<1. Calculated percent pixel intensity difference histograms suggest that the prediction with electron modeling results in a tighter and more regular distribution than the one without electron.

Conclusions:
The inherent buildup is insufficient to remove contamination electrons in 18 MV beams. The fraction of electron signal in PDI varies with field size and MLC modulation efficiency. Incorporating secondary electrons in PDI algorithms improves agreement of PDI comparison metrics.

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Conflict of interest: Supported by Varian Medical Systems