Purpose: Predicted electronic portal imaging device (EPID) response, as calculated by a commercial treatment planning system (TPS), is up to 15% lower than measured EPID response for off-axis IMRT fields. Two original algorithms are presented to correct for EPID prediction errors. The EPID prediction algorithm and a recent image-to-dose conversion algorithm are each tested for ability to identify TPS dose calculation errors.

Methods: By comparing test images to respective predictions, correction factors were calculated to modify the EPID diagonal calibration profile (applied via radial symmetry). Secondly, image/prediction comparisons were used to compute a 2D correction matrix for EPID predictions, to account for radially-asymmetric errors. Over 50 IMRT fields of varying complexity were tested with each correction technique, and with a diode array. Absolute dose and beam-profile errors were separately induced into the TPS and a number of IMRT plans were recalculated and measured with three systems - an EPID prediction system, an EPID image-to-dose conversion system, and a diode array - for comparison to verification plans.

Results: With the profile correction, TPS predictions agree much better with EPID measurements, yielding improvement in gamma pass rates (3%,3mm) of over 30% on average for off-axis IMRT fields. Since off-axis prediction errors are not radially-symmetric, the matrix correction further improves pass rates by 5% on average (up to 30%) for fields where the profile correction is limited. The EPID prediction system was unable to catch either induced TPS error, while both the image-to-dose conversion system and the diode array indicated both errors.

Conclusions: Profile correction is effective and efficient though approximate, due to radial symmetry. The matrix correction is comprehensive but requires computational manipulation of DICOM images. Users must be aware that EPID prediction systems may be unable to catch delivered IMRT inaccuracies due to calculation errors downstream from the actual fluence calculation.