Evaluation of a Novel EPID Based Dosimetry System for Verification of VMAT QA in Comparison with Traditional 3D Detector Quality Assurance.

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Purpose

EPID based dosimetry systems have been largely unavailable for patient dosimetry using the I-ViewGT detector in Elekta Linacs. The purpose of this study is to verify the accuracy of a novel EPID dosimetry system based on a convolution/superposition algorithm by benchmarking its performance against traditional 3D array detector system for VMAT QA.

Methods & Materials

Ten patients with equal mix of 6MV and 10MV beam energies with varying degrees of VMAT plan modulation were randomly chosen for this study. The EPID dosimetry methodology generates a prediction model which reconstructs a 2D-dose map, at 5 cm depth in water at SAD level, from the DICOM RT Plan generated by the TPS. This is then compared to a conversion model which is used to compute a 2D dose map, related to 5cm depth in water at SAD level, from EPID signal values measured using the amorphous silicon detectors in I-ViewGT. The sensitivity of EPID dosimetry to known MLC errors was investigated by applying known MLC offset in both "in" and "out" directions for both leaf banks on the Agility 160 leaf MLC head. 3D detector QA was performed using the Delta4 system.

Results

The gamma pass rates using the 3%/2mm global gamma criteria were greater than 95% for EPID dosimetry and greater than 92.5% for Delta4 measurements for all the selected plans.

When known MLC offsets were introduced by moving the MLC leaf banks "in" and "out" by 1mm each, the EPID dosimetry demonstrated adequate sensitivity to detect introduced errors.

Conclusion

EPID based pretreatment quality assurance can be achieved with the EPIbeam system for fluence verification, and is comparable to traditional 3D detector based QA using the Delta4 system for routine VMAT QA. The system is sensitive to detect MLC errors on the order of 2mm.

Clinical significance:

EPID dosimetry for routine patient IMRT/VMAT QA is an efficient tool that can be performed in a far shorter time frame than 3D detector based measurements. However, EPID dosimetry has been largely unavailable using the I-ViewGT detector on Elekta Linacs. We describe a novel first commercially available system that can be used to verify VMAT QA using I-ViewGT detector on Elekta Linacs.

Sample Results:



Figure 1. Gamma pass rates comparison using 3%/ 2mm threshold between Delta 4 and EPIbeam dosimetry for 10 patients without intentional MLC errors.

EPID Dosimetry Formalism



Conversion Model





Figure 3. EPIBEAM gamma pass rates between calculated and measured EPID dosimetry for Head and Neck patient. **A)** Measured plan without error showing good agreement (97%) **B)** Poor EPIBEAM gamma pass rates (52%) demonstrating adequate sensitivity to detect MLC errors. Measured dose profile lower than expected dose when Leaves are moved in 1mm each leaf bank. **C)** Poor gamma pass rates (69%) demonstrating adequate sensitivity to detect MLC errors. Measured dose profile higher than expected dose when MLC leaves are moved "away" 1mm each leaf bank.