Clinical Implementation of aSi EPID panels for QA of IMRT/VMAT plans

**Purpose:** This work focuses on investigating various issues for clinical implementation of aSi EPID panels for QA of IMRT/VMAT plans.

**Methods:** Six linacs are used in our clinic for EPID based QA; two Varian Truebeams, two Varian 2100 series, and two Elekta Infiniti series. Varian aSi EPID panels have a 40x30 cm² maximum detection area with 1024 x 768 resolution (0.392 mm pixel). Elekta iViewGT EPID panels have a 26x26 cm² maximum detection are with 1024 x 1024 resolution (0.254 mm pixel). Multiple corrections must be taken into account in the calibration of each panel for dosimetric use. Varian aSi panels are calibrated with a standard dark field, flood field, and 40x40 diagonal profile for beam profile correction. However, an off-axis correction is also needed to correct for the panel properties at larger field sizes. Another issue that remains with Varian EPIDs is the backscatter from the support arm, which creates under-response in the superior portion of the panel due to the internal correction factor applied by Varian portal vision software.

Elekta iViewGT system does not export gantry angles at which the image is acquired. A third-party inclinometer must be physically mounted on the back of the linac gantry for this purpose. The needed EPID image versus gantry angle relation is obtained by correlating the recorded inclinometer data via computer clock synchronization. The iView image is time stamped at the end of data acquisition for each image. Thus a T/2 (T is the time interval between two adjacent images acquired) offset needs to be taken into consideration to correctly correlate image and gantry angle for arc plans. iViewGT allows users to adjust EPID settings including number of images acquired during VMAT QA acquisition. Collecting 3 frames per image for VMAT plans works for us clinically providing an adequate number of images for analysis without sacrificing analysis speed and database storage space needed for images.

Both Varian and Elekta panels have a nonlinear MU to dose response at higher energies. Thus a 5 MU 10x10 field is used for calibration versus a standard 100 MU field. The choice of 5 MU stems from a typical IMRT/VMAT MU per segment.

The EPID images are deconvolved into primary MLC fluence maps using DosimetryCheck (or DC) (version 3 release 1, MathResolutions Inc., Maryland, USA) software package. Since a high pass filter in Fourier space deconvolves the images, an artificial exponential term (exp(-u*f²)), where f is frequency) is used to suppress the potential high frequency artifacts. A u value of 0.1 if found to provide a trade off of removing imaging artifacts and losing actual measured signals in high frequency. Deconvolved images are reconstructed into a 3D dose “delivered” to patient and compared to patient 3D dose computed by TPS (Philips Pinnacle version 9.0) using a 3D-gamma analysis.

**Results:** A total of 120 IMRT and 100 VMAT cases (including prostate, pelvis, breast, head and neck, brain, and lung) are reported. Two 3D gamma quantities ( V10 and PTV) are proposed for evaluating QA results and are compared with 2D gammas on same cases. The PTV is sensitive to MLC offsets and V10 is sensitive to both gantry and collimator rotations. It is found that when a 3mm/3% criteria and 90% or higher 3D gamma pass rate is used, all IMRT and 90% of VMAT QA would pass QA.

**Conclusions:** After appropriate calibration and setup of aSi panels and image acquisition systems, EPID based 3D dose reconstruction method is found clinically feasible.