Purpose:A cine-EPID based method to separately measure the mechanical motion characteristics of gantry, jaws and multi-leaf collimator as a function of gantry angle during VMAT has been developed.

Methods:Irradiations were performed using 6 MV beams of a Varian Trilogy linear accelerator with an aS1000 EPID. Images were acquired using 360 MU irradiations at 600 MU/min in cine acquisition mode at 2 Hz frame-rate. To establish the gantry isocentre, a Winston-Lutz technique was used with a circular collimator rigidly attached to the gantry head. The displacement of the centre of a fixed tungsten ball at isocentre from the field centre was determined on each image with a sub-pixel thresholding technique. EPID coordinates were transformed to room coordinates. Jaw and MLC sag relative to the gantry head were determined from the displacement of a gantry-mounted tungsten ball relative to static jaw and MLC positions. MLC speed constancy was determined by segmenting MLC positions on each image for a constant leaf-speed test pattern.Gantry speed constancy was assessed with an independent liquid-based inclinometer and the linac gantry angle potentiometer.

Results:The gantry isocentre was ~ 1 mm amplitude with changes in isocentre occuring over time suggesting frequent measurement is required. Jaw sag was found to be very small ~ 0.2 mm amplitude, with MLC sag ~ 0.6 mm. Average leaf speed was found to be consistent for the MLC leaves however the variation in speed varied systematically across the leaf bank which requires further investigation. Gantry speed was consistent although the inclinometer was found to lag ~ 2 degrees in reading from the potentiometer.

Conclusions:The cine-EPID based method quantifies the mechanical motion characteristics of the linac as a function of gantry angle during arc-therapy with improved precision and efficiency of quality assurance over previous methods

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