AbstractID: 4830 Title: Integral Test Phantom For Dosimetric and Geometric Assurance of IG-IMRT

Purpose:
To develop a combined imaging and dosimetric phantom for the quality assurance (QA) of linear accelerators capable of cone-beam CT image-guided and intensity modulated radiotherapy (IG-IMRT). This integrated approach verifies image quality, registration, and delivery performance.

Method and Materials:
The prototype consisted of a cylindrical imaging phantom (CatPhan) combined with an array of 11 radiation diodes arranged in a plane, oriented perpendicular to the phantom axis. Single diode performance was assessed at 6 and 18 MV (profiles, depth-dose curves and angular dependence) with comparison to ion chamber. The detection of geometric and dosimetric errors in delivery was assessed using an IG-IMRT treatment (6 MV, 7 beams, 180 cGy, CBCT-guided) in which known displacements relative to isocenter were applied. The minimum detectable shift was determined by comparing the discrepancy between planned and measured doses to the dose measurement uncertainty under non-shifted conditions.

Results:
Diode profiles and depth dose curves agreed generally within ±1% with the chamber results. Angular dependence for the diode was low for axial beams (±1%) but increased to a maximum of 11% for out-of-plane irradiation. The normalized dose measurements obtained with the multi-diode phantom agreed well with the planning results. Displacements as small as 1 mm resulted in detectable deviation dose (8.2 cGy SD, n=11) relative to the uncertainty in dose measurements for non-shifted conditions (1.6 cGy SD, n=11).

Conclusion:
A phantom prototype was designed and constructed for comprehensive QA of image-guided radiotherapy in terms of image quality and dose delivery. The results allow us to set specifications for further development. We anticipate the system will permit the localization/detection of sub-millimeters errors in dose gradient placement. Future phantom designs will facilitate absolute dosimetry and investigate the use of additional diodes in different patterns.

Conflict of Interest:
Supported in part by Sun Nuclear Corporation and Elekta Inc.