

Purpose: To validate the dosimetric accuracy and sensitivity of ArcCheck for IMRT and VMAT QA.

Methods: Arccheck is a cylindrical 3D phantom for IMRT and arc delivery. It is a 3D array of 1386 diodes arranged in a helical geometry at a depth of 2.9 cm. The dosimeter was evaluated for dose rate, angular dependence and systematic setup errors. Effect of planning parameters such as couch attenuation and control point (CP) spacing was investigated for various IMRT and VMAT plans. Diodes sensitivity to leaf position errors and gantry errors was studied by simulating errors in various arc delivery plans. Gamma evaluation criteria of 3%, 2mm was used for absolute dose comparison for clinical IMRT and VMAT plans.

Results: Diodes show a dose rate dependency of 2% from 600 to 200 MU/min and 5% below 50 MU/min. An angular dependence of 5% was seen for a 20x30 cm² field size. Prostate and HN IMRT plans delivered at planned angles showed lower gamma passing rate (94.3%) compared to mapcheck measurements (99.3%) delivered at 0° gantry angles. Accounting for couch attenuation in the calculation improved the average passing rate to 97 %. For a 3x40 cm² static arc the gamma passing rate dropped from 92% to 83% when CP spacing changed from 2° to 6° but larger field sizes were not affected. Introducing a 1 mm setup error in AP, LR and SI direction resulted in 5%, 4.5% and 10% drop in passing rate for a HN VMAT plan. A 2mm leaf position error in one leaf and 3° error in one CP showed 6% and 5% difference in profile comparison for various arc deliveries.

Conclusions: ArcCHECK is a robust and sensitive QA tool for IMRT and VMAT delivery. Future work will evaluate a CP by CP analysis to understand complex VMAT deliveries.