

ArcCHECK®-MR

Clinical Experience of Patient-Specific QA for Online Adaptive Radiotherapy Using Elekta Unity MR-Linac

J Yang, et al., UT MD Anderson Cancer Center, Houston, TX, AAPM 2019

- Successfully used ArcCHECK-MR for Patient-Specific QA on 1.5T MR-Linac.

"Our patient-specific QA procedure ensured a safe delivery of online adaptive plan using the Unity MR Linac."

Measurement validation of treatment planning for a MR-Linac

X Chen, Dept of Radiation Oncology, Medical College of Wisconsin, J Appl Clin Med Phys 2019;20:7:28-38

- Study using IC PROFILER-MR and ArcCHECK-MR to confirm that 1.5T Unity's MR affects were correctly accounted for in the TPS.
- ArcCHECK results were excellent, ~99% passing rates

First MR-Guided Online Adaptive Patient Treatment in North America On An In-Room High Field (1.5 T) MRI Linac

S Vedam, et al., MD Anderson Cancer Center, Houston, TX, AAPM 2019

- Used ArcCHECK-MR for Patient-Specific QA on first adaptive treatments on Elekta's new Unity 1.5T MR-Linac.

Comprehensive commissioning of MR-Linac online adaptive radiotherapy QA

O. Green, et al. Washington University School of Medicine, Radiation Oncology- Physics Division, Saint Louis, USA, ESTRO 2019

- Validated ArcCHECK-MR as part of a quality assurance process for online adaptive radiotherapy (ART) performed with a MRIdian MR-Linac.

"The complexity of online adaptation necessitates not only thorough commissioning but the establishment of on-going comprehensive quality assurance for each fraction that includes not only a phantom-less QA but also a method to ensure that all other components of the plan are accounted for and checked."

Performance of a cylindrical diode array for use in a 1.5 T MR-linac

Houweling A. et al., Physics in Medicine and Biology, 61(3) (2014)

- Study examining the performance characteristics of the ArcCHECK-MR in a transverse 1.5T magnetic field.

"The short term reproducibility, dose linearity, dose rate dependence, field size dependence, dose per pulse dependence and inter-diode variation of the ArcCHECK-MR diodes were not influenced by the presence of a 1.5 T magnetic field. Therefore, the ArcCHECK-MR can be used for QA of patient plans in the MR-linac."

- No significant differences between the performance of the MR-linac and the clinical linac were observed.

Patient-specific quality assurance for the delivery of (60)Co intensity modulated radiation therapy subject to a 0.35-T lateral magnetic field.

Li HH. et al., Int J Radiat Oncol Biol Phys, 91(1):65-72 (2015)

- This publication reviews a patient specific dosimetry quality assurance (QA) program for IMRT using ViewRay®, the first commercial magnetic resonance imaging-guided RT device.

Examines the use of ArcCHECK-MR as part of a patient-specific intensity modulated radiation therapy quality assurance (QA) program for ViewRay.

AC-MR measurements indicated the mean SD passing rate using 3% relative/3 mm gamma criteria was 98.9%.

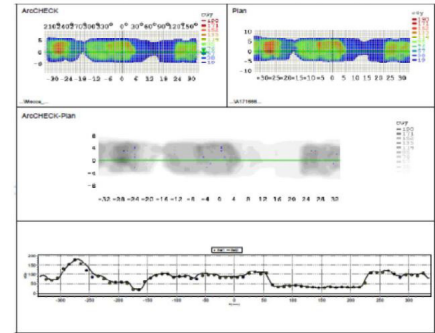
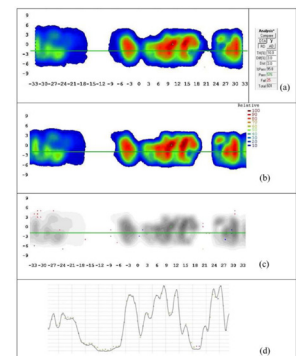


FIG. 7. A comparison of measured and calculated dose maps for an IMRT plan. Top Left: Dose distribution of the QA plan on ArcCHECK CT. Top Right: Dose distributions on the patient CT. Bottom: Comparisons of doses measured (ArcCHECK) and calculated (Plan) as analyzed with SNC Patient™.

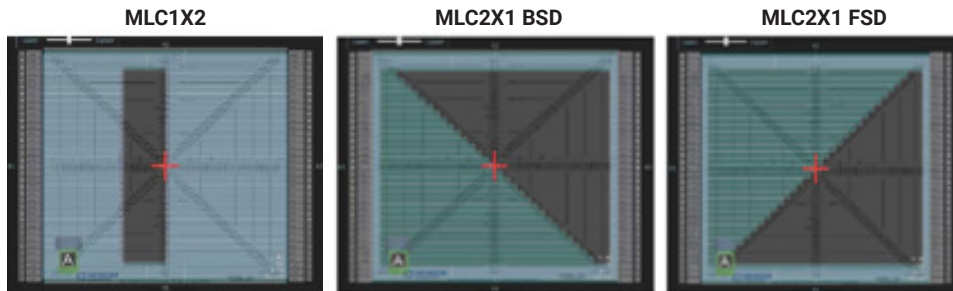


IC PROFILER™-MR

Characterization of positional accuracy of a double-focused and double-stack multileaf collimator on an MR-guided radiotherapy (MRgRT) Linac using an IC PROFILER array

K Mittauer, et al, Med. Phys. 47 (2), February 2020 0094-2405

- Summary: Adaptive MLC QA using IC PROFILER-MR, efficient MLC QA for Daily use
- Sensitivity of 0.5-1mm depending on Half Beam Block or Diagonal test
- *"The high correlation between detector response and MLC error of both procedures enabled a direct quantification of the MLC positional accuracy"*



Measurement validation of treatment planning for a MR-Linac

X Chen, Dept of Radiation Oncology, Medical College of Wisconsin, J Appl Clin Med Phys 2019;20:7:28-38

- Study using IC PROFILER-MR and ArcCHECK-MR to confirm that 1.5T Unity's MR affects were correctly accounted for in the TPS.

Performance of a multi-axis ionization chamber array in a 1.5 T magnetic field.

Smit K. et al., Physics in Medicine and Biology, 59(7) (2014)

- This publication investigates the performance of the IC PROFILER™, a multi-axis ionization chamber array, in a 1.5 T magnetic field.

"The linearity, reproducibility, pulse rate frequency dependence, panel orientation and ionization chamber shape are unaffected by the magnetic field."

IC PROFILER™ dose profiles were compared with film dose profiles obtained simultaneously in the MR-linac. Deviation between the film and the IC PROFILER™ data was caused by the noise in the film, indicating correct performance of the IC PROFILER™ in the transverse 1.5 T magnetic field."

The MD Anderson experience with 3D dosimetry and an MR-linac

Geoffrey S. Ibbott, Hannah J. Le and Yvonne Roe Department of Radiation Physics, UT MD Anderson Cancer Center, Houston, TX; 10th International Conference on 3D Radiation Dosimetry, IOP Conf. Series: Journal of Physics: Conf. Series1305 (2019) 012011k

- MRIdian publication on MR affects to beam; uses IC PROFILER-MR and ArcCHECK-MR.
- Shows good IC PROFILER-MR agreement when using MR-specific array calibration.
- On ArcCHECK-MR, user should use factory array calibration or perform the calibration on a standard (non-MR) linac until a similar MR-specific procedure is developed.

Detectors

Lateral dose response of an ionization chamber in an external magnetite field

M. Alissa, et al., Institute for Medical Physics and Radiation Protection, University of Applied Sciences Mittelhessen, Giessen, Germany, ESTRO 2022

- Monte Carlo study using SNC125c in a 1.5 Tesla field. Shows Lorentz effect to a magnetic field in the X, +Y, and -Y directions.

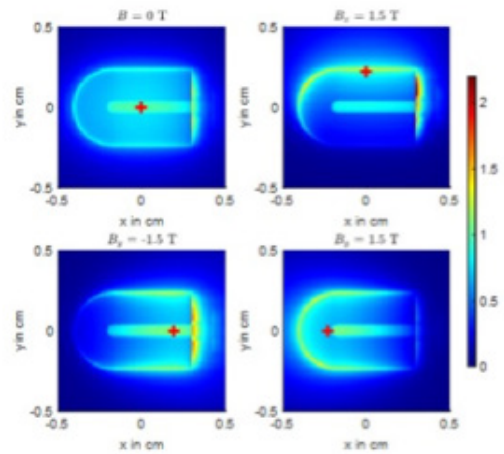


Figure 1: Spatial resolved relative dose within the sensitive volume of the SNC125c ionization chamber as a function of the pencil beam position.

Monte Carlo calculation of magnetic field correction factors for two ionization chambers

M. Alissa, et al., University of Applied Sciences Mittelhessen, Institute for Medical Physics and Radiation Protection, Giessen, Germany, ESTRO 2022

- Study applying Monte Carlo to determine the dosimetric impact of the Lorentz effect on the SNC600c and SNC125c
- *“Results: In case, where the magnetic field is parallel to the chamber axis (B_x), k_B of the SNC 600c and the SNC 125c changes in dependence of the magnetic field strength B_x up to 1% and 0.5% respectively. In this case the Lorentz force directs the secondary electrons perpendicular to the chamber axis, as a result the correction factor k_B is symmetrical around $B_x = 0$ T.”*