Absolute Dosimetry Using a Novel Portable Water Calorimeter Design in MR-linac

08/01/2018, 10:15AM, Karl Dean A1

Measuring absorbed dose using water calorimetry is essential for accurate clinical radiation dosimetry. This work presents a novel calorimeter design for use in an MR-linac

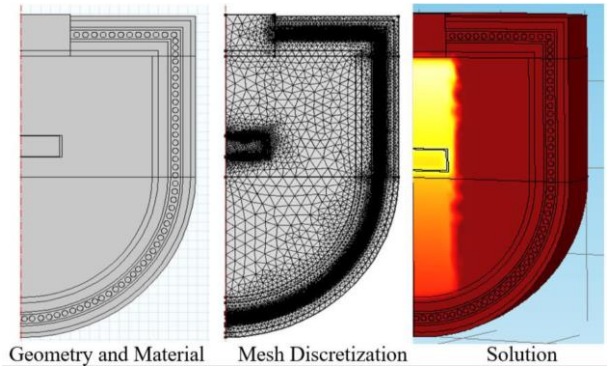

Fig 1 (above) : FEM modeling of heat transport was used to optimize the water calorimeter design. The modeling consists of: Designing of a fully MR-compatible calorimeter (left), A mesh discretization of the geometry space (middle), and an analysis of the resulting spatially-varying, time-dependent solution (right).

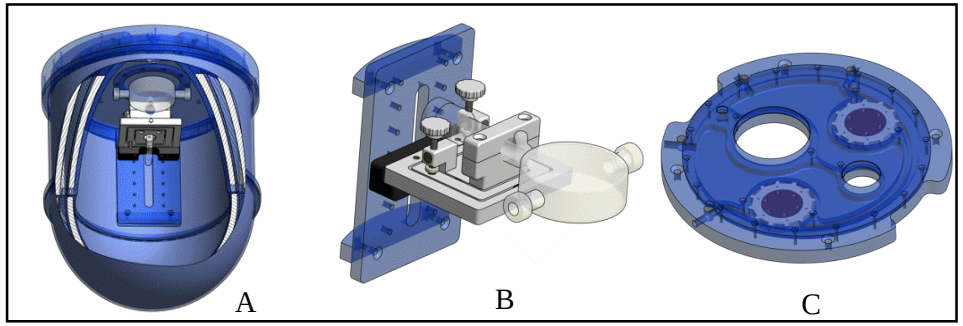

Fig 2 (above): Schematics of the optimized calorimeter design showing: The water tank and holder (A), the glass vessel holder assembly allowing for minute positioning adjustment (B), the removable top lid of the calorimeter with opening for radiation entrance, passageway for coolant fluid, as well as two hydraulically driven mechanical stirrers.

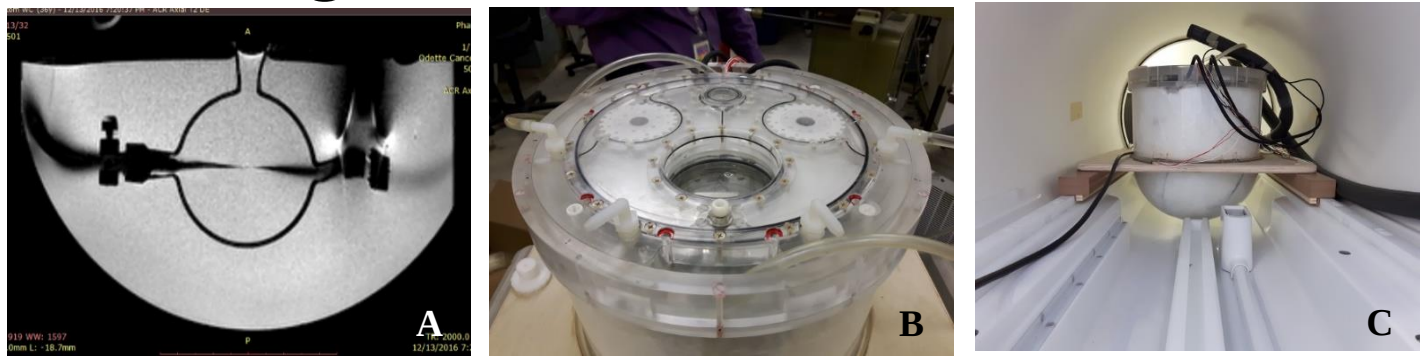

Fig 3 (above): The thermistors clearly visible in an MR-image of the calorimeter used for accurate positioning (A). Design shown with the top attached (B). The fully assembled calorimeter in the bore of the Elekta MR-linac (C). The calorimeter was kept and operated at a constant 4˚C temperature.

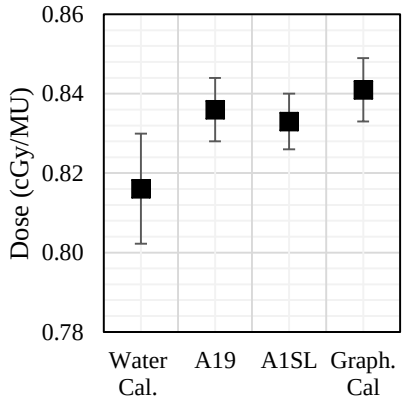

Fig 5 (above) : Comparing the uncorrected measured absolute absorbed dose to the values measured by reference dosimetry ionization chambers and an independent graphite calorimeter. All measurements in absence of B field).

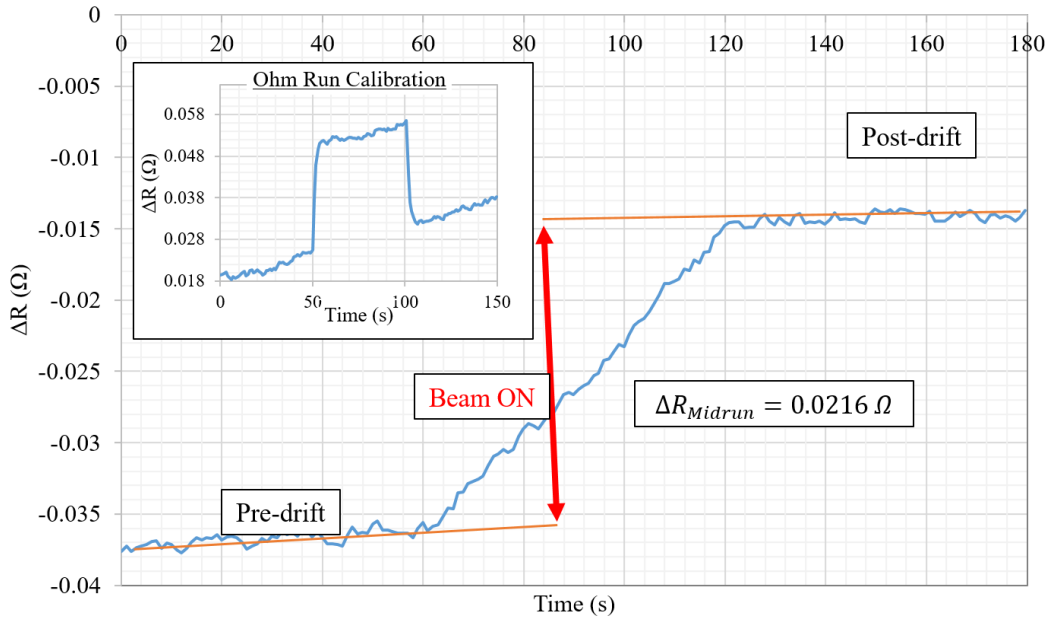

Fig 4 (left): Results of one out of the 31 irradiation runs in MRL. The beam on corresponds to the radiation beam on delivery by MRLinac. The subset in the top left is a sample 'Ohm Calibration'; the resistance of the decade box (burster) was changed by 1 Ω allowing for a voltage-resistance calibration.

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