Purpose: To investigate the clinical application of a Monte Carlo treatment planning system for verification of fixed-field IMRT and RapidArc® treatment plans.

Methods: The McGill Monte Carlo treatment planning (MMCTP) system was used to calculate dose distributions from fixed-field IMRT and RapidArc plans that had been generated in Eclipse v8.6 using the AAA dose calculation algorithm. Planar dose measurements were performed using the MapCHECK 2 diode array in three different measurement geometries. The first measurement geometry collapsed all of the gantry angles to 0° for the treatment delivery, and was only possible for the fixed-field IMRT plans. The second measurement geometry used an Isocentric Mounting Fixture (IMF) that rotated the MapCHECK 2 array while the gantry rotated during RapidArc delivery. The third measurement geometry placed the MapCHECK 2 array between two 6 cm Solid Water® slabs with the detector remaining stationary on the treatment couch while the gantry rotated during RapidArc delivery.

Results: A benchmark head and neck fixed-field IMRT plan demonstrated excellent agreement between the Eclipse calculations, MMCTP calculations, and the MapCHECK 2 measurements for the collapsed gantry angle geometry. The Eclipse and MMCTP calculations were generally in good agreement for the RapidArc plans, but differences of up to 7% were seen in high dose gradient regions. For the RapidArc plans, the MapCHECK 2 results agreed well with the calculated distributions for stationary measurements between the Solid Water slabs but had poorer agreement when the IMF delivery was used.

Conclusions: This work demonstrates that MMCTP can be used as an independent verification of fixed-field IMRT and RapidArc treatment plans. MapCHECK 2 measurements between the Solid Water slabs agreed well with the calculated results and were the preferred QA method since the measured distributions best simulated the intended dose distributions in the patient's treatment plan.