Clinical Experience with 3D Monte Carlo Secondary Dose Calc System for Robotic Radiosurgery Stereotactic Treatments

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Abstract

Objectives:

We report on our initial experience with clinical implementation of a Monte Carlo 3D secondary dose check software, for stereotactic treatments (SRS/SBRT) using a robotic radiosurgery system.

Methods:

Our healthcare system has two new Cyberknife S7 systems (Accuray, Sunnyvale, CA) equally configured with MLC, Iris and Cone collimators delivering SRS/SBRT and IMRT treatments. We sought to share an enterprise resource secondary dose check software system, in line with AAPM TG 219 recommendations, that indicates one set of beam data could be used for commissioning the secondary dose check system for equivalent radiation treatment units. The first S7 system, which was commissioned utilizing a PTW micro silicon detector model TN60023 for the Precision treatment planning system, was also independently scanned utilizing a PTW diamond detector model TN60019 for VeriQA (PTW, Freiburg, Germany) beam modeling requirements as per manufacturer recommendations. The second S7 system was clinically commissioned using the diamond detector but was not scanned for VeriQA beam modeling. Both clinical sites generated CT to density table using the Tissue Characterization Phantom Model 467 (Gammex, Middleton, WI) in respective CT scanners for VeriQA and Precision.
A mix of forty patient plans using Cone, Iris and MLC for both Monte Carlo and RayTrace algorithms were analyzed in VeriQA with a gamma passing criteria set at 3%, 1mm, 2 %, 2mm, and 3%, 3mm. Of the total 40 cases, 18 plans were Brain SRS/fSRS, 8 SBRT lungs, 6 Prostate SBRTs; the rest were 1 liver SBRT, 2 SBRT adrenal, 3 spine and 1 pancreas SBRTs, 1 H&N SBRT plans.

Results:

The beam data between the two machines agreed within +/-3%. Of the 40 cases initially analyzed in VeriQA, 35 cases pass the gamma passing criteria of 2%, 2mm; 39 cases pass 3%, 3mm criteria.

Conclusion(s):

With the complexity of stereotactic treatments, a robust independent secondary MU check becomes pertinent. TG 219 recommends use of a full 3D calc, moving away from point dose calcs previously used in clinics. Based on these results, VeriQA system can utilize a single set of beam data within 3 percent accuracy, and provide secondary dose calculations passing to 97.5% (39 cases) with 3% , 3mm criteria. For a 3D monte carlo secondary check system, these results indicate that the VeriQA system is clinically capable of providing a sufficient accuracy for multiple machines of the same type.