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Abstract

Patient Specific Quality Assurance for Stereotactic Radiosurgery (SRS) Treatment Plans Generated for Novel Self-Shielded Radiosurgery System

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Abstract

Objectives: Patient-specific quality assurance (PSQA) is an integral component in the successful implementation of stereotactic radiosurgery (SRS) treatments. Recently the first clinical ZAP-X (ZAP Surgical System Inc., San Carlos, CA) system was installed at our institution and a PSQA program was developed to ensure the accuracy of the measured versus delivered dose distributions prior to the delivery of the actual clinical treatment. Here, we present our initial experience in the development of PSQA for this novel SRS treatment delivery system and report our PSQA results for the first 30 treatments.

Methods: Our PSQA methodology includes absolute dose measurements with an ion chamber (IC) and relative planar dose measurements with film. Absolute dose was measured with a PTW PinPoint IC in a 3D SRS Lucy phantom (Standard Imaging, Inc., Middleton, WI) and planar dose was measured with Gafchromic EBT3 films placed in either the axial or sagittal plane in the Ball Cube insert within the Accuray head phantom (Accuray Inc., Sunnyvale, CA). Both phantoms were scanned on a Philips Brilliance Big Bore CT scanner with 1mm slice thickness, and the CT DICOM data was sent to the ZAP-X treatment planning system (TPS). PSQA plans were generated for each patient's treatment plan by centering the dose cloud on the IC's active volume for absolute dose, and on the Ball Cube insert containing EBT3 film for planar dose. For all plans 300 cGy was prescribed to the 50% isodose line for film dosimetry. Each phantom was separately set up on the ZAP-X treatment unit using a pre-treatment imaging workflow, which compares planar kilovoltage images acquired at a several gantry positions to digitally-reconstructed radiographs generated from the TPS. After plan delivery, the exposed film was scanned by using an Epson 10000XL flatbed scanner and converted into dose using a calibration curve. Film calibration was performed by exposing specific doses ranging from 0-700cGy to films placed at a depth of maximum dose (dmax) in a solid water phantom. SNC patient software (Sun Nuclear Inc., Melbourne, FL) was used for planar dose evaluation, comparing the measured film dose distribution to the corresponding planar dose extracted from the TPS using gamma analysis. We have performed film based dosimetry for all 30 patients treated thus far on the ZAP-X system, with target volumes ranging from 0.03cc-26.51cc

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(average: 2.94cc) and prescription doses ranging from 14-20Gy @ 50-80% isodose line (single fraction) and 25-30Gy @ 50-55% isodose line (five fractions). Measured ion chamber doses were compared to the TPS-calculated mean chamber doses. Absolute dose measurements using the IC were performed for the first five patients.

Results: The average gamma passing rate for film-based PSQA was 98.46% (range: 94.00%-100%) at (2%, 2mm) and 83.72% (range: 55.10%-100%) at (2%, 1mm). For our ion chamber-based PSQA, the TPS and IC measurements agreed to within 1.4% (range: 0.97%-2.84%).

Conclusions: PSQA shows a good agreement of absolute and planar dose measurements compared to TPS calculations for all patients treated thus far with the ZAP-X SRS system.