Cureus

Feasibility of Log-based SRS/SBRT Patient-Specific Pre-Treatment Quality Assurance

Open Access
Abstract
Published 02/11/2022

Bao Zhao [1] , Stephanie Wang [2] , Joshua Kim [2] , Brian Bismack [2] , Karen Snyder [2] , Ning Wen [2] , Indrin J. Chetty [2] , Yimei Huang [1]

1. Medical Physics, Henry Ford Health System, Detroit, USA 2. Radiation Oncology, Henry Ford Health System, Detroit, USA

Corresponding author: Bao Zhao, bzhao1@hfhs.org

Categories: Medical Physics
Keywords: per fraction, imrt qa, pre-treatment qa

How to cite this abstract
Zhao B, Wang S, Kim J, et al. (February 11, 2022) Feasibility of Log-based SRS/SBRT Patient-Specific Pre-Treatment Quality Assurance. Cureus 14(2): a787

Abstract

Objective: SRS/SBRT pre-treatment patient specific quality assurance (PSQA) is usually performed with detectors, such as chamber, film, or detector array. Recently, commercial solutions, such as Sun Nuclear's PerFraction, can reconstruct three-dimensional dose from plan delivery logs. In this study, we evaluated the feasibility of implementing PerFraction's Fraction 0 (Fx0) as a supplement of, or replacement for, traditional detector based PSQA for SRS/SBRT plans.

Methods: Nine SRS/SBRT clinical plans were studied, including single-iso multi-target cranial SRS, fractionated SRS (fSRS), and lung SBRT. The plans were generated in Eclipse (AAA, v15.6) using either VMAT or IMRT technique and mapped to a solid water phantom for PSQA. To simulate "delivery errors", each plan was modified within deliverability limits using 5 different strategies: (1) Monitor Unit (MU) scaling (±1-4%) of all control points in the plan, (2) MU modification to a subset of control points, (3) 1 mm change in MLC position, (4) 2 mm change in MLC position, (5) 0 to 1.5 mm random opening of MLC position. Each of the 9 plans was delivered with and without introduced errors, resulting in 54 total deliveries. Measurements were made in the phantom using a pinpoint microchamber (PTW). GafChromic EBT3 (Ashland) film was also included in a subset of deliveries. Reconstructed dose from Fx0 (Sun Nuclear Dose Calculator using CCC algorithm) was compared to chamber and film results as well as to planned dose from Eclipse in phantom geometry.

Results: Compared to clinical plans, introduced errors caused a relative change in chamber results of -13% to 21% for individual fields, or 3% to 11% in plan composite dose. Fx0 was able to detect all introduced errors with a mean difference between Fx0 and chamber of -0.06±0.57%. Strong correlation (r>0.95) was observed in both per beam and plan composite analysis, and the best correlations (r>0.99) were observed in MU scaling, MU modification, and 0 to 1.5 mm random MLC opening. The introduced error resulted in gamma passing rates (3%, 1mm) as low as 68% when comparing film results with planned dose in clinical plans. Fx0 was consistent with film in catching the introduced errors as gamma passing rates between film and Fx0 were all greater than 97%.

Conclusion: Log-based Fx0 was as sensitive to the introduced errors as chamber and film for this set of measurements. It can potentially be implemented as a supplement for detector-based PSQA measurement in SRS/SBRT plans.