Evaluating Agreement between the Treatment Planning System and a Novel Secondary Dose Verification Software for 1.5T MR-Linac

Sunday, July 21, 2024

3:00 PM - 4:30 PM

Exhibit Hall | Poster Lounge (Los Angeles Convention Center (LACC))

Session: General Poster Discussion (Group A)

Program: Poster Program

Category: Science Program General Poster Discussion (GPD)

Abstract

Purpose: Quality assurance in radiation therapy involves secondary dose calculations, often performed using commercial software. Current dose verification systems require manual adjustment for magnetic field effects for application on Magnetic Resonance Imaging Guided Linear Accelerators (MR-Linac). Importantly, discrepancies between treatment planning systems (TPS) and current verification software for MR-Linac have been reported, emphasizing the need for a more accurate dose verification software in magnetic fields. ThinkQA, developed for Elekta Unity MR-Linac, utilizes a collapsed cone convolution (CCC) model to calculate dose distributions. This study aims to provide agreement rates observed between ThinkQA and the TPS to allow future users to postulate pass/fail thresholds for various anatomical sites.

Methods: The agreement between the TPS and ThinkQA-calculated dose distributions were evaluated retrospectively for 413 plans from 50 patients who received radiation therapy on the Unity. The 3%/2mm global gamma analysis criteria were employed to calculate gamma pass rates, following vendor recommendations and AAPM TG219 guidelines. Agreement rates were stratified based on anatomical site and target volume, and analyzed using descriptive statistics in Microsoft Excel.

Results: Mean agreement rates (%) and standard deviations among High-Dose regions were: 99.44, 0.57 (Spine); 99.36, 0.60 (Prostate); 99.04, 0.96 (Pelvis); 97.74, 10.79 (Abdomen); 96.48, 4.17 (Brain); 93.92, 7.16 (Breast); 92.14, 5.50 (Head and Neck); and 67.52, 32.29 (Thorax). Other target volumes followed similar trends.

Conclusion: Gamma pass rates demonstrated variability by treatment site with all being above 90% except for Thorax. Currently, the ThinkQA algorithm does not account for the electron return effect (ERE), leading to failures at the air-tissue interface and likely contributing to low agreement rates in the heterogenous Thorax region. The efficiency of the CCC model was noted; however, use of additional subvolumes unaffected by the ERE, and long-term dosimetric correction for ERE within the algorithm, may address such low agreement rates.

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