Cureus

Open Access
Abstract

Validation of Robotic Radiosurgery Target Tracking for APBI Treatments Using a Bioabsorbable Fiducial Array and Plastic Scintillating Detector

Jonathan Hill [1] , Jesse McKay [2] , Marian Axente [3]

1. Radiation Oncology, Erlanger Health System, Chattanooga, USA 2. Physicist, Erlanger Health System, Chattanooga, USA 3. Radiation Oncology, Erlanger Medical Center

Corresponding author: Jonathan Hill, jonathan.hill@erlanger.org

Categories: Medical Physics, Radiation Oncology
Keywords: accelerated partial breast irradiation, stereotactic body radiation therapy, plastic scintillating detector

How to cite this abstract
Hill J, Mckay J, Axente M (April 02, 2020) Validation of Robotic Radiosurgery Target Tracking for APBI Treatments Using a Bioabsorbable Fiducial Array and Plastic Scintillating Detector. Cureus 12(4): a498

Abstract

Objectives: The CyberKnife VSI platform (Accuray, Inc) (CK) can track fiducial markers via the Synchrony tracking system to compensate for respiratory motion. The goal of this project was to validate the accuracy of tumor site tracking and dose delivery for accelerated partial breast irradiation (APBI) on a robotic linear accelerator using the Biozorb (Hologic, Inc) three-dimensional, bioabsorbable fiducial array.

Methods: Biozorb is a 3D implant with six titanium clips that is available in different sizes. In this study, a 2cm x 3cm spiral implant was suspended in a custom, gelatin mold (mix of 20g of 225-bloom gelatin in 350mL water). An Exradin W2 plastic scintillating detector (PSD) (Standard Imaging, Inc) was inserted into the gel with the 1mm cylindrical sensitive volume positioned within the space defined by the fiducials. The phantom was placed on a motorized platform to simulate 1.5cm amplitude periodic motion in the anterior-posterior (AP) dimension, analogous to breathing-induced breast motion. The phantom was scanned into Multiplan (Accuray, Inc) and an isocentric plan using the smallest available collimator (5mm) was made to deliver 3.6Gy to the active PSD volume. This created a 2.6 mm (AP) x 2mm ellipsoidal uniform dose cloud centered at the PSD active volume, intrinsically smaller than the motion amplitude and marginally larger than the PSD active volume. This achieved a delivery scenario sensitive to the induced motion. Breathing trace definition and marker tracking was done with the Synchrony system.

Results: The difference between the mean planned and measured doses was -5.9%. Previous work indicates that the W2 PSD measured a smaller output factor (OF) compared to the more traditional diode detector measurement used for TPS commissioning. Correcting for the OF difference gave a dose agreement of 0.75% for the 5mm cone. This shows that, when tracking Biozorb implants with Synchrony, interplay can be minimized and the target localized with =1.3mm spatial accuracy when breathing motion up to 1.5cm amplitude is introduced. Since Biozorb consists of six titanium clips attached to the 3D spiral structure, markers bunch closer together in space as model size decreases. Further analysis may be needed to assess if the Synchrony system can achieve the same level of accuracy in delivery for different size implants. Additionally, a novel application for a small-volume PSD was demonstrated in this study. The small dimensions of the detector and light pipe allowed for non-destructible phantom-insertion and negligible field perturbation. The lack of high density detector material also assured no

Open Access
Abstract
Published 04/02/2020

interference in marker tracking.

Conclusions: Planned versus measured dose evaluation shows the Synchrony tracking algorithm has the robustness to expand its application to APBI using 3D breast cavity-specific fiducial arrays.