Cureus

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Abstract

Dosimetric Feasibility of Delivering Lattice Radiotherapy for Breast Cancer using Stereotactic Radiotherapy

Benjamin Kopchick [1] , Huijun Xu [2] , Niu Ying [3] , Cedric Yu [4]

1. Physics, The George Washington University, Washington, USA 2. Central Maryland Radiation Oncology, University of Maryland, Columbia, USA 3. N/a, Xcision Medical Systems, Columbia, USA 4. Radiation Oncology, University of Maryland

Corresponding author: Benjamin Kopchick, kopchickbp@gwu.edu

Categories: Medical Physics, Radiation Oncology
Keywords: grid, spatially fractionated radiation therapy (grid), lattice radiotherapy, microbeam radiotherapy

How to cite this abstract
Kopchick B, Xu H, Ying N, et al. (August 21, 2018) Dosimetric Feasibility of Delivering Lattice Radiotherapy for Breast Cancer using Stereotactic Radiotherapy. Cureus 10(8): a350

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OBJECTIVES: A stereotactic radiotherapy device that recently received FDA clearance for treating breast cancer, GammaPod, can deliver large fractional doses to breast targets up to 5cm in diameter according to a Phase 1 clinical trial. For larger bulky tumors, lattice radiotherapy, or 3D spatial fractionation, is thought to be effective in reducing tumor volume that can be achieved similarly by 2D grid therapy that is delivered by Linac using MLC or brass compensator. This study investigates the dosimetric feasibility of incorporating lattice radiotherapy technique in GammaPod. By delivering regularly spaced spots of high doses surrounded by areas of very low dose, this new design of GammaPod could possibly treat large tumors for breast conservation.

METHODS: In the new design using Monte Carlo simulation, GammaPod was equipped with 5mm diameter non-coplanar circular beams that span 36 degrees latitudinally from 18 to 53 degrees off the horizontal plane. Two degrees longitudinal intervals were used to simulate rotating beams. To testify the performance of GammaPod for different breast sizes, three water-equivalent hemisphere targets of dimensions 10cm, 15cm, and 20cm were involved. For these targets, 30 - 224 shots were generated during treatment planning. Shot spacing of 2 cm in the transverse and sagittal planes and 2.5 cm in the coronal plane was used. The maximum dose for each individual shot was 20Gy. The peak-to-valley dose ratio and skin dose were analyzed.

RESULTS: The dose profiles showed a reduction from the peak-to-valley dose of 86%-96% in 10cm breast, 80%-96% in 15cm breast, and 80%-92.5% in the 20cm breast. The average skin dose was 1.5Gy, 3.2Gy, and 3.7Gy for the 10cm, 15cm, and 20cm breast respectively. Additionally, the maximum doses were 21.6Gy, 23.1Gy, and 24.9Gy. These numbers are like those reported in studies for grid therapy.

CONCLUSIONS: GammaPod-based lattice therapy is a viable alternative to conventional grid therapy and its application can be extended to treating large bulky breast tumors.

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Published 08/21/2018