Cureus

Open Access
Abstract
Published 04/02/2023

Impact of Onyx™ Embolization on 6MV Flattened and Unflattened Photon Beams in Stereotactic Radiosurgery/Radiotherapy (SRS/SRT) Planning: A Monte Carlo Analysis

Sumeesh S [1] , Shaiju VS [2] , Sarin B [2] , Raghukumar P [2]

1. Radiation Physics Division, Regional Cancer Centre Thiruvananthapuram, Ernakulam, IND 2. Radiation Physics Division, Regional Cancer Centre Thiruvananthapuram, Thiruvananthapuram, IND

Corresponding author: Sumeesh S, sumeesh88.s@gmail.com

Categories: Medical Physics, Radiation Oncology
Keywords: unflattened photon beams, flattened photon beams, radiotherapy treatment planning, onyx

How to cite this abstract
S S, VS S, B S, et al. (April 02, 2023) Impact of Onyx™ Embolization on 6MV Flattened and Unflattened Photon Beams in Stereotactic Radiosurgery/Radiotherapy (SRS/SRT) Planning: A Monte Carlo Analysis. Cureus 15(4): a938

Abstract

Objectives:

To evaluate the dosimetric impact of Onyx™ material artifacts on dose calculations of the Eclipse® Anisotropic Analytical Algorithm (AAA) and Acuros®XB (AXB) Algorithm against PRIMO Monte Carlo dose calculations for 6MV flattened and unflattened photon beams in Stereotactic Radiosurgery/Radiotherapy (SRS/SRT) Planning.

Methods:

In this study, PRIMO MC Simulation software (http://www.primoproject.net/) Version 0.3.64.1800 was used. Validation of phase space files for 6MV flattened and unflattened photon beams for True BeamTM (Varian Medical Systems®) linear accelerator (LINAC) was done by comparing the measured and the simulated percentage depth dose (PDD) and transverse profiles, for various field sizes using the gamma index evaluation tool provided by the PRIMO MC code. An indigenously fabricated head phantom with a central spherical cavity of 10mm diameter was filled with approximately 0.7 ml Onyx embolic material. To evaluate the impact of the Onyx™ material artifact, two sets of CT images were generated with and without embolization. These CT sets were divided into different volumes by drawing three concentric spherical shells, starting at a distance of 5 mm from the isocentre of the phantom. Two separate plans for AAA and AXB are created in both CT sets (Set 1 and Set 2) using different field techniques. Among the different field techniques, the first plan was a four-field box technique. The second plan was a seven-field IMRT plan with a gantry angle separated by 520. The third plan was a fixed jaw VMAT single Arc with a full rotation. All plans are created with a fixed jaw size of 5×5 cm2 and are set to deliver a pre-set monitor unit (MU) of 200. The TPS plans in DICOM format (plan, dose, structure, and images) were then imported into PRIMO for MC calculations. The integral doses for each ring structure in both the CT sets were determined. The dose distribution with and without Onyx™ related artifacts for 6MV flattened and unflattened photon beams were compared using the gamma index evaluation tool provided by the PRIMO MC code with the acceptance criteria of 2%, 2 mm.

Results:

The gamma analysis with acceptance criteria of 2 mm DTA and 2% dose difference shows good agreement between the measured and simulated curves. The Integral Dose variations for 3 rings are calculated and compared between two CT sets for both 6MV flattened and unflattened photon beams. The dose deviations were found significant in the shell proximal to Onyx material and get reduces as it goes away from Onyx. The mean dose deviations to Ring 1 are lower for PRIMO MC when compared to AXB and AAA and it was observed that there is a reduction in the mean dose for the 6 MV unflattened photon beam as compared to the flattened beam.

Conclusion(s):

In this work, we assessed the impact of Onyx™ material artifacts on 6MV flattened and unflattened photon beams using AAA and AXB algorithms against PRIMO MC Code. This study aids the users in selecting the appropriate dose calculation algorithm and energy, where artifact-generated heterogeneity is prominent during stereotactic radiosurgery/radiotherapy planning.