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RESPIRATORY MOTION INFLUENCE EVALUATION IN THE 3D DOSE DELIVERY FOR BREAST CANCER RADIOTHERAPY TREATMENTS USING SIMULTANEOUS INTEGRATED BOOST (LASSD-2021)

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Introduction: Breast cancer is the most common type of cancer in women. For early staged cases, its treatment is based on conservative surgery and postoperative radiotherapy. The influence of respiratory motion on dose delivery is one of the main concerns in breast radiotherapy treatment, especially for Intensity-modulated radiation therapy (IMRT) or IMRT associated with simultaneous integrated boost (SIB) techniques. This study evaluates the influence of respiration on the 3D dose distribution of SIB breast cancer treatments using gel dosimetry.

Material and method: The respiratory motion was simulated by a platform with three different oscillation amplitudes (0.34 cm, 0.88 cm, and 1.22 cm). A batch composed of nine calibration vials (12.00 cm length and 1.02 cm diameter) and five breast phantoms (500 ml volume, 7 cm height, and 15 cm diameter), all filled with gel dosimeter (MAGIC-f), were prepared. The first phantom was used as a reference, the second one was statically irradiated, and the others were irradiated using the three amplitudes.

The SIB plan was planned on the computed tomography (CT) of the static phantom filled with water using a 6 MV Unique LINAC for irradiation in the Eclipse Treatment Planning System (TPS) both from Varian Medical Systems. The plan consisted of fives beam (gantry angles: 255°, 270°, 300°, 60°, and 100°). The whole phantom received a dose of 1.8 Gy, and the simultaneous boost of 2 Gy was delivered to a circular region of 2 cm diameter, according to Figure 1. The gel measured 3D dose distribution was obtained with relaxometry maps in MRI (Phillips Achieva 3T scanner) of the phantoms and achieved using a multi spin-echo sequence (8 TEs multiples of 35 ms, 1000 ms TR, 2 mm image thickness, voxel size of 0.6 x 0.6 x 2 mm^3 and a 256 x 256 pixels acquisition matrix).

The respiratory motion influence in the dose distributions was evaluated by comparing the relaxometry maps of the static phantom with the moving ones using a 3D gamma analysis (3%/3 mm/15% threshold).

Results: The percentage of approved points comparing the static phantom with the oscillating ones were 96.62%, 96.30%, and 96.42%, for the amplitudes of 0.34, 0.88, and 1.22 cm, respectively. The gamma approval per slice can be seen in Figure 2, and the SIB region is between slices 25 and 40, where most fails are observed.

Conclusions: The simulated respiratory motion for the breast phantom treatment using SIB did not significantly affect the total gamma pass rates. However, it was observed that the SIB region had the lowest approval percentage. This indicates that considering the small SIB volume compared to the whole phantom, the fails in this region were not enough to reduce the overall gamma result.

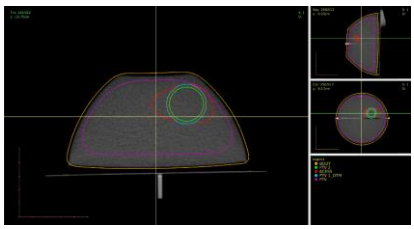

Figure 1. IMRT SIB plan CT phantom view.

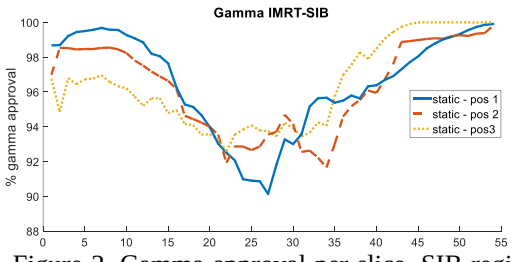

Figure 2. Gamma approval per slice. SIB region between slices 25-40.