

Image-Guided Radiation Therapy (IGRT) Analysis of Preoperative Partial Breast Radiosurgery

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Abstract

Objectives: Two institutional IRB approved clinical trials (Phase I and Phase II) have accrued 50 patients with T1N0M0 breast cancer since 2009 for preoperative partial breast radiosurgery. This study analyzed the images taken during IGRT in order to review patient positioning and motion.

Methods: Target volumes were breast tumor plus a 1-1.5cm margin for CTV and an additional 3-5 mm margin for PTV. IMRT plans were utilized to deliver 15, 18 and 21 Gy in a single fraction for 8, 8 and 34 patients, respectively. At the time of treatment, patients were first aligned with the skin marks and then OBI was used at 5 time points. (1) Initial orthogonal 2D KV images, (2) pre-treatment 3D CBCT images, (3) pre-treatment orthogonal 2D KV images, (4) 2D kV images mid-treatment (for the last 15 patients only), and (5) post-treatment orthogonal 2D KV or 3D CBCT images were taken. Patient position was corrected by automated translational couch shifts to align to the biopsy clip. The IGRT analysis focused on the magnitude of the corrections from each imaging time point.

Results: The mean directional shifts and standard deviations at the 5 time points were (1) (-0.07+/-0.55, 0.24+/-0.46, -0.14+/-0.91), (2) (-0.13+/-0.35, -0.05+/-0.19, -0.02+/-0.30), (3) (-0.04+/-0.10, 0.01+/-0.05, -0.01+/-0.04), (4) (-0.11+/-0.19, -0.01+/-0.08, -0.02+/-0.05), and (5) (-0.17+/-0.23, -0.08+/-0.14, -0.02+/-0.16) from 46 patients in cm and in the vertical, longitudinal, and lateral directions, respectively. The mean combined vector magnitude shifts and standard deviations were (1) 0.96+/-0.69, (2) 0.33+/-0.40, (3) 0.05+/-0.12, (4) 0.16+/-0.17, and (5) 0.27+/-0.24 in cm. (1) Initial shifts were the largest due to large distance between skin marks and the biopsy clip in the breast tumor. (2) Using CBCT, the biopsy clip and overall breast shape were aligned for 3D verification. For 8 patients, patient position was adjusted in the room and a second CBCT performed. (3) To confirm patient positioning, a second set of 2D orthogonal images were taken just before the treatment began and negligible shifts found for all patients. (4) For the last 15 patients, 2D kV images were taken mid-treatment. Although small on average, a couch shift of 4-5 mm was performed for 2 patients. The KV imaging directions were designed to optimize the efficient and effective IGRT performance. (5) Post-treatment KV images were taken to confirm patient position at completion of treatment in addition to time points (3) and (4). We primarily found shifts in the anterior direction in the time points (2) to (5). Patients tended to roll more into the ipsilateral breast board opening as they relax on the breast board. The mean IGRT time was 40.7+/-14.9 minutes.

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Abstract

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Conclusions: This study reviewed IGRT for preoperative partial breast radiosurgery. Aside from initial kV images, each imaging interval resulted in only small positioning corrections, confirming accurate patient positioning throughout treatment delivery and supporting the utilized PTV margin. Throughout our 7-year experience, we have improved our IGRT procedure allowing for more accurate and efficient breast radiosurgery.