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**Multidisciplinarity and
Innovation in Stereotactic
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Evaluating the Treatment Planning Performance of Whole Breast Irradiation with a Boost Using a Novel Fast Iterative Shrinkage-Thresholding Algorithm

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Objectives: Previous studies have explored definitive radiation therapy as an option for breast cancer patients who are either medically inoperable or decline surgery. Some of these studies employed conventional whole-breast irradiation (WBI) followed by a stereotactic body radiotherapy (SBRT) boost focused on the primary tumor. This study investigates the application of an innovative fast iterative shrinkage-thresholding algorithm (FISTA) for fluence map optimization in WBI combined with an SBRT boost for these patients.

Methods: We selected three breast cancer patients (two with left-sided tumors and one with a right-sided tumor), all with tumor sizes ≤ 5 cm, from the cancer imaging archive (QIN-breast) based on 18-fluorodeoxyglucose (FDG) PET/CT DICOM data. For treatment planning, we contoured the affected breast using CT data and delineated the gross tumor volume (GTV) for the SBRT boost using a combination of PET and CT data. Clinical target volume (CTV) and planning target volume (PTV) were defined with 15-mm and 3-mm margins around the GTV and CTV, respectively, as per the ROCK Trial (NCT03520894) guidelines. Additionally, we excluded a 5-mm margin around the skin surface, thoracic wall, and pectoral muscles from the CTV and PTV. Treatment plans for WBI and SBRT boost prescribed 50 Gy in 25 fractions to the whole breast and 21 Gy in 3 fractions to the PTV, respectively, using a research version of the RefleXion® treatment planning system (X1-TPS), which employs collapsed cone convolution/superposition for dose calculation. We analyzed the dose distribution to the heart, ipsilateral and contralateral lungs, and contralateral breast.

Results: In WBI, the dose coverage (D95%) for the whole breast was 98.7%, 96.6%, and 97.1%, respectively. The mean lung dose (MLD) for the three WBI plans was 10.36 Gy, 5.68 Gy, and 5.62 Gy for the ipsilateral lung and 2.11 Gy, 2.35 Gy, and 2.37 Gy for contralateral lungs, respectively. The mean heart dose (MHD) and V5Gy for the patient with right breast cancer were 2.62 Gy and 2.10%, while the average \pm SD MHD and V5Gy for the patients with left breast cancer were 3.10 \pm 0.28 Gy and 6.00 \pm 1.13%, respectively.

For the SBRT boost, tumor sizes were 2.6 cm, 3.1 cm, and 4.8 cm, and the PTV coverage (D95%) was 97.6%, 98.2%, and 98.8%, respectively. The MLD for the ipsilateral lung was 1.44 Gy, 1.02 Gy, and 1.04 Gy, and for contralateral lungs, it was 0.55 Gy, 0.74 Gy, and 0.74 Gy, respectively. The MHD for the patient with right breast cancer was 0.92 Gy, while the MHD for the patients with left breast cancer was 1.73 Gy and 1.91 Gy, respectively.



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Conclusion(s): This study evaluated the feasibility of utilizing a FISTA optimizer for treatment planning in the context of WBI followed by an SBRT boost. Further clinical investigations are essential to validate these findings and assess the oncologic and cosmetic outcomes associated with this approach.

