JULY 12–16
2020 VIRTUAL
JOINT AAPM | COMP MEETING
EASTERN TIME [GMT-4]

Advanced Whole Breast Radiation Therapy for Node-Negative Left-Sided Breast Cancer Patients

Yibo Xie[1], D Bourgeois[2], B Guo[1], Rui Zhang[1,2]

1. Louisiana State University, Baton Rouge, LA
2. Mary Bird Perkins Cancer Center, Baton Rouge, LA

LSU Department of Physics & Astronomy

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INTRODUCTION

Breast cancer has the highest incidence rate among women in the US other than skin cancer. Women diagnosed with early-stage breast cancer who have lumpectomy usually underwent whole breast radiation therapy (WBRT) after surgery, which can lower recurrence and metastasis rates and make lumpectomy as effective as mastectomy. The current standard of care (SOC) for WBRT in the US is using parallel-opposed tangential photon fields. However, significant dose inhomogeneity can occur within the irradiated volume and can cause poor cosmetic outcomes, especially for women with large breasts.

AIM

To investigate whether field-in-field (FIF), hybrid intensity-modulated radiation therapy (IMRT), IMRT, standard volumetric modulated arc therapy (STD-VMAT), non-coplanar VMAT (NC-VMAT) and multiple arc VMAT (MA-VMAT) can provide comparable coverage as the current standard of care (SOC) while reducing doses to organs at risk (OARs) for whole breast radiation therapy (WBRT) patients.

METHOD

- 15 patients who received left side lumpectomy and treated with SOC tangential beams were retrospectively studied.
- FIF plans utilized the same beam angles and energies as the SOC plans, and subfields were manually added to eliminate hotspots. Hybrid IMRT plans included a pair of open tangent fields and a pair of dynamic IMRT tangent fields.
- IMRT plans included 7 beams equidistantly distributed in a sector of 180° that avoided direct exposure to the contralateral breast.
- Two tangential arcs at co-planar plane were used for STD-VMAT.
- Two tangential arcs that with 20° and 340°couch angle were used for NC-VMAT.
- Six coplanar partial arcs that each covered 50° were used for MA-VMAT.
- All plans used a prescribed dose of 50Gy in 25 fractions. Collimator was rotated for each arc to align with the long axis of planning target volume (PTV) for STD-VMAT, MA-VMAT and NC-VMAT.

RESULTS

- All techniques produced clinically acceptable WBRT plans. The dose distributions and DVHs for a typical WBRT patient are shown in Figures 1 and 2.
- For the two forward planning techniques, FIF plans not only show better PTV coverage but also provide superior OAR sparing than SOC. Five inverse planning techniques show superior OAR sparing than two forward planning techniques.
- STD-VMAT provides good sparing of contralateral breast at the cost of a larger low dose cloud for lung and heart.
- MA-VMAT plans show the most optimal OARs sparing and minimum risk of developing late side effects among all inverse planning techniques.
- NC-VMAT provides the most conformal PTV coverage and good sparing of lung and heart.

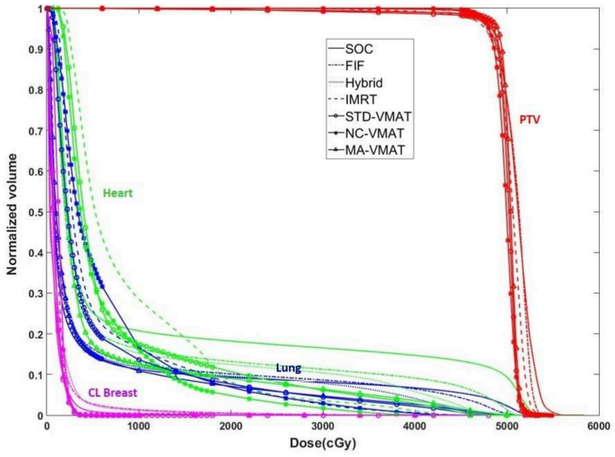

Figure 1. DVHs for SOC, FIF, Hybrid IMRT, IMRT, standard VMAT, NC-VMAT and MA-VMAT plans for a typical PMRT patient.

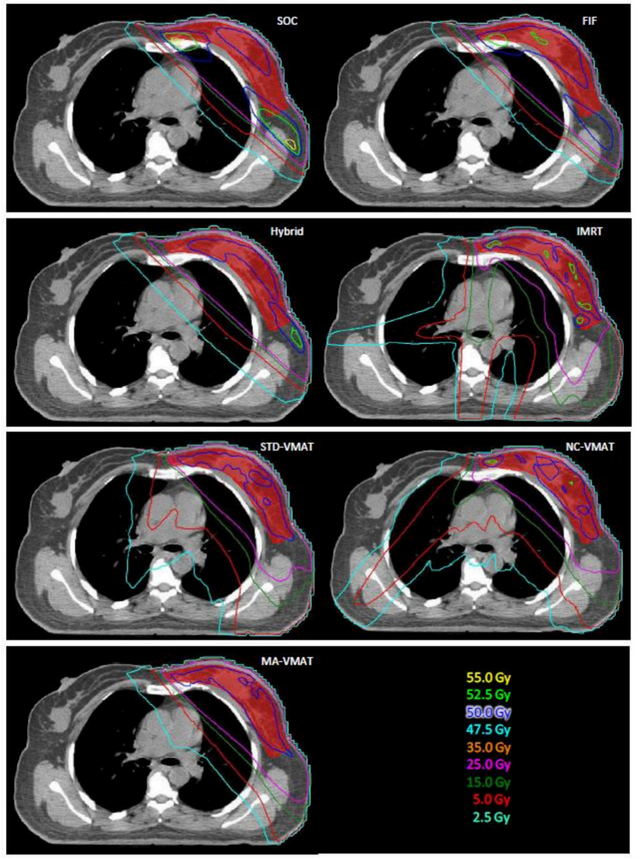

Figure 2. Axial view of isodose distribution for SOC, FIF, Hybrid IMRT, IMRT, standard VMAT, NC-VMAT and MA-VMAT plans for a typical WBRT patient. The red color wash represents the PTV-Eval.

CONCLUSIONS

MA-VMAT and NC-VMAT could be the optimal radiation technique for certain early stage breast cancer patients after breast conserving surgery.

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CONTACT INFORMATION

yxie14@lsu.edu (Yibo Xie, Ph.D.)