Hypofractionated Partial Breast Mixed Photon/Electron Technique – A Case Study

Authors: Heather Parks, CMD, Ming Xu, PhD, Michael Stutz, MD, Robert Foster, MS DABR CMD, Stacey Schmidt, CMD

Northwestern Medicine Cancer Centers, Geneva, IL and Warrenville, IL

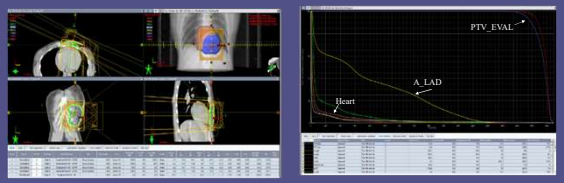
Purpose

The objective of the case study was to evaluate a mixed modality technique to decrease dose to Organs-At-Risk (OARs) and improve the coverage to superficial medial targets for partial breast 3D planning, achieving clinically acceptable results. To the authors knowledge, this is the first report of 3D partial breast planning technique using mixed photon and electron modalities. There have been reports using VMAT, Static IMRT, and photon 3D planning.

Methods

Two patient treatment plans were generated using a 3D conformal photon plan with Electronic Compensator (EC) in conjunction with a single, enface electron field. Inverse planning was not used. Varian Eclipse Version 16 was utilized. The field arrangements varied based on the location of target to OARs. Once the fields were added field weighting was optimized. The contribution from the electron field was no more than 50% of the daily dose. Moreover, it was physician preference to use the least amount of dose from the electron field. This specific technique was selected for superficial targets where an electron energy could sufficiently cover the target or at least retain coverage with this supplemental dose. The composite plan of photon and electron beams was evaluated to meet dose constraints to targets and OARs.

Case 1



Case 1: Left Partial Breast, Prescription is 30Gy in 5 fractions QOD. Planned using mixed energy, Photon + Electron (4 static fields-2 field non-coplanar and 2 coplanar-using 6x-FFF in combination with the Electron field 6e+0.3cm bolus). Bolus was utilized to improve expected dose coverage to the PTV_EVAL. The photon fields were planned using ECs. Photon dose=400cGy/fx and the Electron dose=200cGy/fx; Total dose is 600cGy/fx

Field 1: Gantry=300; Collimator=0; Couch=330; 6x-FFF

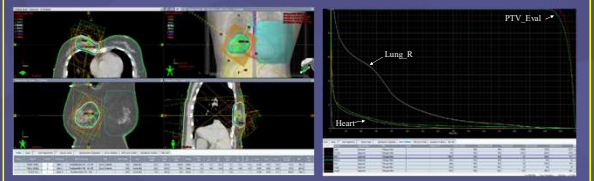
Field 2: Gantry=300; Collimator=0; Couch=30; 6x-FFF

Field 3: Gantry=110; Collimator=0; Couch=0; 6x-FFF

Field 4: Gantry=295; Collimator=0; Couch=0, 6x-FFF

Field 5: Gantry=5; Collimator=0; Couch=0; 6e with 0.3cm bolus; Scaled to the 85% isodose line

Case 2



Case 2: Right Partial Breast, Prescription is 30Gy in 5 fractions QOD. Planned using mixed energy, Photon + Electron (2 static fields, non-coplanar, using 6x-FFF in combination with the Electron field 12e). The photon fields were planned using ECs. Photon dose=350cGy/fx and the Electron dose=250cGy/fx; Total dose is 600cGy/fx

Field 1: Gantry=40; Collimator=330; Couch=290; 6x-FFF

Field 2: Gantry=30; Collimator=345; Couch=70; 6x-FFF

Field 3: Gantry=10; Collimator=330; Couch=0; 12e (No bolus); Scaled to the 90% isodose line

Results

This unique partial breast technique resulted in advantages in plan quality with OAR sparing, mainly to heart and contralateral breast while maintaining PTV coverage. We observed an increase in overall hotspots compared to conventional 3D planning due to the addition of the electron field. This hotspot could be partially manipulated with the EC fields.

Case1: Based on the Florence Trial (Meattini et al) and NM (Northwestern Medicine) Consensus for dose reporting, the Heart V300cGy is 7.7% with a goal < 10%; Left Ventricle mean dose is 154cGy with a goal < 300cGy; LAD mean is 746cGy with a goal < 1000cGy. The PTV_EVAL V2850cGy was 98.3% and fell short of the goal of 100%, OAR sparing was favored over target coverage.

Case 2: The dose constraints, as referenced in Case 1, were utilized in this case. The contralateral breast (Breast_L) D0.03cc <100cGy; Lung_R V1000cGy was 19.8% with a goal < 20%; Heart V300cGy is 11.3% with a goal <10%; PTV_EVAL V2850cGy is 99.7% with a goal of 100%.

Conclusion:

This is a novel technique using a conformal photon beam arrangement with the addition of an electron field. The ease and simplicity of this technique can prove to be effective or superior to other planning methods such as static field IMRT or VMAT for achieving dose conformality and OAR avoidance in partial breast planning. It has been clinically demonstrated to be a reliable and efficient 3D technique for medially located, superficial targets. More cases may be needed to further support this non-traditional technique.

Email: Heather.Parks@nm.org

Northwestern Medicine