

AbstractID: 3016 Title: Enhancing magnetically collimated electron beams for breast cancer treatments

Purpose: To develop magnetically collimated electron beams and to study their feasibilities for breast tumor bed irradiations

Method and Materials: We constructed an enhanced magnetic collimator with a beam aperture of 5.5 cm from permanent magnets using high-density Neodymium-Fe compounds. The collimator is cylindrical in shape and can be mounted at the end of an electron cone. The magnetic field is symmetrically aligned with the beam axis. The central axis of the magnetic field was calculated via finite element analyses and validated with Hall probe measurements. To implement magnetically collimated electrons for breast tumor bed irradiations, we measured and modeled the central axis depth doses and dose profiles of magnetically collimated electron beams on a flat water phantom. An empirical pencil-beam model was developed to calculate three-dimension dose distributions of magnetically collimated electron beams in CT studies. We implemented the dose model for breast tumor bed treatment cases.

Results: Based on the dose distributions of the fixed and the arc beams of magnetically collimated electrons on the flat water phantom, the entrance dose is significantly lower than the conventional electrons (< 30% of the maximum dose). When treating the breast tumor bed, conformal dose distributions to the tumor volume are achieved with magnetically collimated electrons in contrast to single enface beam dose distributions. Isodose surface such as 90% of the maximum dose can be used to fully cover a target volume at depth.

Conclusion: It is feasible to produce magnetically collimated electron beams with appropriate beam apertures. Conformal dose distributions from magnetically collimated electrons potentially create new regimens for breast tumor bed treatments.