

AbstractID: 13287 Title: Dosimetric impact of CT metal artifacts on proton pencil-beam scanning delivery

Purpose: To quantify the dosimetric impact of CT metal artifacts on proton pencil-beam scanning and passive scattering delivery. To develop a novel metal artifact reduction method to reduce artifacts in CT simulation images.

Method and Materials: A tissue characterization phantom was scanned on a wide-bore CT simulation scanner with and without metallic inserts. Original projection data was obtained for these scans. Images have been reconstructed with filtered back projection using both the original projection data and a version in which the projections through metal are restored with a 2-dimensional interpolation method. A target volume (GTV) was defined in the center of the phantom. Dose errors were calculated by planning on the artifact-affected images and calculating the dose on the ground truth images without artifacts.

Results: Dose errors in the plan for passive scattering delivery mainly occurred around the edge of the GTV, caused by the range shift of the beams. The impact of metal artifacts on pencil-beam scanning delivery is much greater; interplay between the pencil-beams and local image artifacts results in dose errors of up to 18% inside the GTV. The dose errors in both plans could be reduced to 3% by applying the metal artifact reduction method to the CT data. Also, tissue structure that was originally hidden could largely be restored, which in patient plans can facilitate better delineation of the tumor and organs-at-risk.

Conclusions: This work shows that metal artifacts in the CT simulation scan for proton pencil-beam scanning delivery can result in significant under- and overdosage inside the GTV, which could lead to poor tumor control. A metal artifact reduction method has been developed and shown to reduce proton dose errors.