AbstractID: 5037 Title: EUD-assessed Impacts of Respiratory Motion on Breast Irradiation

Purpose: Respiration results in intrafractional motion and anatomic changes for both target and normal structures (e.g., lung, heart) during the radiation treatment for breast cancer. The purpose of this work is to quantify the dosimetric and radiobiological impacts using the concept of equivalent uniform dose (EUD).

Method and Materials:

Intrafractional variations were assessed based on 4DCT datasets acquired using a GE LightSpeed-RT scanner and Varian RPM-respiratory-gating system. The 4DCT datasets along with the conventional 3DCT images for 10 patients were analyzed retrospectively. Each set of 4DCT consisted of 10 CT image sets at a phase between 0-90% during one respiration cycle. For each case, a 3D dosimetric plan of two tangential beams irradiating the whole breast was generated based on the 3DCT images using Xio (CMS) planning system. The parameters for this dosimetric plan (e.g., energy, beam angles, beam shape, wedge, weighting, isocenter location) were copied to each phase image set of the 4DCT to generated 3D dose distribution. DVHs for each phase image set were generated and were used for EUD calculation based on LQ model for breast tumor and Lyman model for lung.

Results: 4DCT showed breast position/shape and lung position/shape/volume are changed with respiration. For example, lung volume changed up to 20% for the cases studied. These changes result in significant intrafractional variations in dose distributions/DVHs. Our calculations show that, compared to the planned EUD (based on the 3DCT), the breast EUD was lowered by an average of 5% (when including all 10 breathing phases) and up to 10% (at a particular phase). Lung EUD varied by ±3% during respiration.

Conclusion: Respiratory motion in breast radiation treatment can potentially result in decreased target coverage and normal structure sparing. This effect that can be assessed using EUD, and decreased EUD may be an indicator for gated breast irradiation.