AbstractID: 8477 Title: Radiobiological optimization of breast cancer radiotherapy taking into account patient positioning, breathing and radiation pneumonitis scoring

Purpose: Significant discrepancies in dose delivery can contribute to underdosage of the tumor or overdosage of normal tissue. To study the impact of patient positioning and internal organ motion in breast cancer radiotherapy, the setup and breathing uncertainties characterizing three different irradiation techniques are employed.

Material and Methods: Fifteen breast cancer patients (5 resected with negative nodes (R-), 5 resected with positive nodes (R+) and 5 ablated), who were treated with three different irradiation techniques are examined. The positioning uncertainties in the anteroposterior (AP) and the craniocaudal (CC) directions are approximated by Gaussian distributions and breathing is assumed to be linear. The combined frequency distributions of the positioning and breathing distributions are obtained by convolution. The three radiation techniques are compared by using the complication-free tumor control probability, P_+ and the biologically effective uniform dose (BEUD).

Results: For the R- case, at the optimum dose levels of the two dose distributions, the P_+ values are 97.9% and 97.3%, respectively. The respective total control probabilities, P_B are 99.3% and 99.1%, whereas the corresponding total complication probabilities, P_I are 1.4% and 1.8%. For the R+ case, the P_+ values are 94.2% and 93.0%, respectively. The P_B values are 97.5% and 96.3%, whereas the P_I values are 3.3% and 3.3%. For the Ablation case, the P_+ values are 96.9% and 89.4%, respectively. The P_B values are 99.0% and 96.5%, whereas the P_I values are 2.1% and 7.2%. In this case, for lung radiation pneumonitis Grade 1-2 the P_+ values would change to 69.3% and 37.7%, respectively.

Conclusions: The combined effects of positioning uncertainties and breathing motion can introduce a significant deviation between the planned and delivered dose distributions to the lung in breast cancer radiotherapy. This inaccuracy in the delivered dose may lead to a significant underestimation of the expected lung complications.