Purpose:

In radiotherapy treatments of breast patients, respirations may introduce uncertainties in target and heart locations. This study is to investigate the dosimetric impacts of these uncertainties in breast radiation treatments.

Method and Materials:

A 4D CT scan and a conventional helical CT scan set were acquired on each of 7 left breast patients and 5 right breast patients. Using the helical CT scan, a conventional 3D conformal plan, consisting of two tangential beams, was generated per physician's evaluation and decision. The 4D CT scan set was divided into 10 phases over the respiratory cycle. On each phase, treatment target and heart were contoured. Dose distributions were generated using the same beams as in the conventional plan. Software was developed to compute the cumulative dose distribution (4D doses) from all the phases. This 4D CT image based cumulative dose distribution would be closer to that in reality with motions taken into account. Various dosimetric parameters were obtained for treatment target and heart from the conventional plan and from the 4D cumulative dose distributions and compared to deduce the motion induced dosimetric impacts in breast radiation treatments. Studies were performed for both whole and partial breast treatments.

Results:

For whole breast treatment, the motion induced changes in D_{95}, D_{max}, and D_{min} of PTV were $0.88\% \pm 20\%$, $-0.28\% \pm 0.65\%$, and $-10.17\% \pm 47\%$, respectively. For left breast, the motion induced D_{max} change in heart was $22\% \pm 48\%$. For partial breast treatments, the motion induced changes in V_{90} and D_{min} of CTV were $1.6\% \pm 2.7\%$ and $3\% \pm 4\%$, respectively.

Conclusions:

Breathing motion may cause cold spots in the whole breast treatment, and may compromise treatment quality for some patients. It may also increase heart maximum dose. However, for the partial breast treatment, the motion impact may be insignificant with properly selected margin size.

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