Evaluation of the respiratory motion influence in the 3D dose delivery of breast cancer radiotherapy treatments using Simultaneous Integrated Boost

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Breast cancer is the most common type of cancer in women and, for the early staged cases, its treatment is based on conservative surgery and postoperative radiotherapy. One of the main concerns in the breast radiotherapy treatment is the influence of the respiratory motion on the dose delivery, especially for the most conformal dose techniques, such as IMRT or Simultaneous Integrated Boost (SIB). To answer this question, this study evaluates the influence of respiration on the 3D distribution of the dose in breast cancer treatments using IMRT with SIB technique by using gel dosimetry. The respiratory motion was simulated by a platform with 3 different oscillation amplitudes (0.34 cm, 0.88 cm and 1.22 cm). Five breast phantoms filled with the gel dosimeter (MAGIC-f) were prepared, the first one was used as reference, the second was irradiated static and the others were irradiated using different amplitudes, nine small calibration vials were also made. The SIB plan was prepared on the CT of the static phantom filled with water, a dose of 1.8Gy was delivered to the whole phantom, and a simultaneous boost of 2Gy was delivered to a circular region of 2cm diameter in the middle of the phantom. After the irradiation of the phantoms, the 3D dose distribution was obtained by MRI, using a multi spin echo sequence and the relaxometry maps, which are related to the dose, were calculated by software developed by our Group. The respiratory motion influence in the dose distributions was evaluated by comparing the relaxometry maps of the static phantom with the moving ones using a 3D gamma analyses (3%/3 mm /15% threshold). The percentage of approved points comparing the static phantom results with the oscillating results in the amplitude of 0.34 cm was 96.62%, for amplitude of 0.88 cm was 96.30% and for amplitude of 1.22 cm was 96.42%. As a conclusion, it was noticed that the simulated respiratory motion with amplitudes in the range of 0.34 cm to 1.22 cm, for breast cancer treatments using SIB for the proposed breast phantom containing the 2cm circular target, did not affected the dose distribution significantly.