Investigation of In-Vivo Dosimetry for Deep Inspiration Breath-Hold Technique in Breast Cancer Radiotherapy

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Purpose

Breast cancer (B.C.) is the most common of cancer among women worldwide. The treatment of B.C is decided, according to the stage of the tumor. External RT is one of the treatment modalities of B.C. Especially in patients with left B.C, reduction of irradiated heart of breast is crucial.

Organ movements controlled Breath-hold RT technique (BHRT) is one of the methods which is being used for the treatment of left sided B.C. Techniques to be applied to the patient should be controlled carefully. The most precise way to determine the accuracy of treatment is 'In-vivo Dosimetry (IVD)'.

In this study, the availability of in-vivo dosimetry was investigated for high accuracy applicability of the deep inspiration breathhold (DIBH) RT technique.

Methods

For IVD, TLD and OSL dosimetry systems were used. Before IVD measurements begin, open field surface dose responses of TLD and OSL dosimeters were investigated in different depths and field sizes. In our study, we chose markus parallel plate ion chamber as a reference dosimeter. Results were normalized to the dose at dmax (1.5 cm for 6 MV). Dosimeters are made from different materials and each of them has its own effective depth of measurement.

For a decent surface dose measurement, water equivalent thicknesses (WETs) of dosimeters should be taken into account. The physical effective point of measurement for Markus p.p. ion chamber was defined as 0.023 mm, at the inner surface of the proximal collecting plate. In this study, OSLs were used in closed configuration and the effective measurement depths for closed have been reported to be 0.85 mm. The use of TLD dosimetry requires great attention because the effective measurement distance changes according to the TLD material. It was taken the middle point of TLDs as the effective measurement distance, 0.4 mm. To obtain the dose at 0.07mm depth, an interpolation calculation was made by comparing the PDD data to a four-order polynomial fit of Markus chamber measurements in the buildup region. For TLD and OSL dosimeter measurements, extrapolation was made because their effective depths of measurement were just above the phantom. To compare the results, doses at the same points were obtained. For the same field sizes and depths, doses were calculated in Eclipse TPS, measured and calculated results were compared.

Results

Early stage 10 left breast cancer patients underwent CT scans with breath control system and RT plans were created by using FinF technique. It was aimed to investigate the compliance of the doses received during the treatment with the intended doses of the patients by IVD. The skin depth was assumed to be 0.07 mm, the depth recommended in the ICRU 39 report.

Doses calculated in TPS were compared by measured doses which were obtained by placing the TLDs and OSLs at 3.5,5,8 and 15 cm (contralateral breast) distances from the center of the beam on the patient’s skin and around the thyroid organ in every single fraction.

Conclusions

Measured and calculated contralateral breast dose differences change from patient to patient. Similar to open field percentage depth dose measurements, surface dose measurements by using OSL and TLD have been found to be approximately 15% greater than TPS. OSL vs TLD results were found similar and both of them are suitable for skin dosimetry. Cumulative dose can be obtained by using OSL, therefore it can be preferred for IVD.