Out of field dose for three imaging modalities in case of image guided prostate cancer radiotherapy

C. Le Deroff, R. Lefeuvre, J. Bouvier, R. de Crevoisier, C. Lafond

PV-104 Out of field dose for three imaging modalities in case of image guided prostate cancer radiotherapy

C. Le Deroff[1], R. Lefeuvre[1], J. Bouvier[1], R. De Crevoisier[1,2], C. Lafond[1,2]
[1]Centre Eugène Marquis, Radiotherapy, Rennes, France; [2]Univ Rennes- CLCC Eugène Marquis- Inserm- LTSI-UMR 1099, Radiotherapy, Rennes, France

Purpose or Objective

In prostate image guided radiotherapy (IGRT), a recent randomized trial reported an occurrence of other malignancies two times higher in case of a daily imaging control compared to a weekly control *(de Crevoisier, IJROBP 2018)*. The purpose of this study was to measure the additional out of field dose delivered by various imaging modalities.

Material and Methods

An anthropomorphic phantom was used to mimic a total dose of 78 Gy delivered in the prostate by IMRT/IGRT. We measured the dose related to three imaging techniques (a pair of orthogonal portal images (PI) (6 MV, 2 UM/image), a pair of orthogonal kV images (75 kV, 10 mAs and 105 kV, 80 mAs) and a standard full kV-CBCT (125 kV, 676 mAs)). The doses were measured for 21 points along the central axis of the phantom with thermoluminescent dosimeters (GR-200A). These doses were compared to the measured doses related to the treatment (IMRT, 5 beams, 6 MV, sliding window technique). Finally, the doses for various kV-CBCT parameters were computed: a low dose (260 mAs) and a high dose protocol (1300 mAs).

Results

Figure 1 shows the measured out of field dose for the three imaging modalities for one fraction/control. Orthogonal kV imaging (2D-kV) provides the minimum dose inside (1.12 mGy at 0 cm) and outside the field (0.11 mGy at 20 cm, corresponding to 10 cm from the imaging field edge). Standard kV-CBCT imaging provides less dose inside the field (18.6 mGy at 0 cm) than PI (28.8 mGy at 0 cm) but more dose outside the field (1.36 mGy at 20 cm) compared to PI (0.87 mGy at 20 cm). The high dose kV-CBCT protocol provides the maximum out of field dose (2.62 mGy at 20 cm), while using a low dose kV-CBCT protocol provides less dose (0.52 mGy at 20 cm) than PI. The out of field doses related to IMRT are superior to all the imaging control modalities (8.65 mGy at 20 cm).

Considering a weekly control by 2D-kV imaging (8 controls) and a daily control by a standard kV-CBCT imaging (39 controls), the doses at 20 cm were 0.90 mGy and 53.1 mGy, respectively. However, when considering a daily control by 2D-kV imaging and a weekly control by a low dose kV-CBCT imaging the doses are similar with 4.3 mGy at 20 cm.

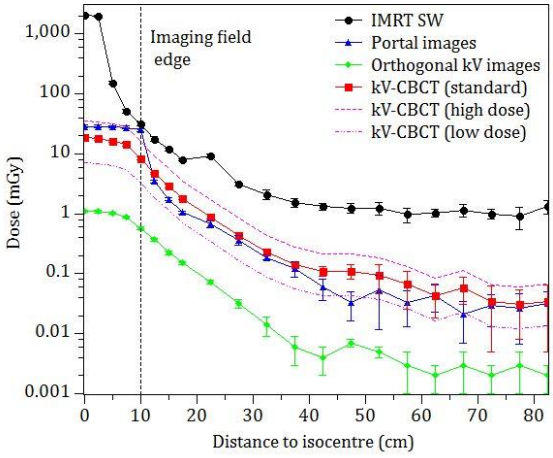

Figure 1: Measured dose profiles for one fraction of IMRT (SW: sliding window technique), one pair of orthogonal portal images (6 MV, 2 MU/image), one pair of orthogonal kV images (75 kV 10 mAs, 105 kV 80 mAs) and one full kV-CBCT (125 kV) with either 260 mAs (low dose), 676 mAs (standard) and 1300 mAs (high dose). The origin represents the treatment and imaging isocenters and is located at the prostate barycenter.

Conclusion

Both imaging modality and control frequency as well as treatment fields have an impact on the out of field dose. Regarding one imaging control session, the out of field dose ranges from 0.1 to 2.6 mGy at 10 cm from the imaging field edge.