Purpose: Evaluation of different calculation methods for dose modification due to intrafraction prostate motion using film measurements as ground truth.

Methods: We acquired intrafraction motion data with the Calypso tumor tracking system by Varian Medical Systems Inc for 4 prostate IMRT patients treated with 35 fractions each. These motion data were transferred to a phantom platform which reproduces the observed motion and has a 20 cm diameter cylindrical solid water phantom mounted. For each patient all fractions were irradiated on one radiochromic MD-V2-55 film placed in the isocentric transversal slice of this phantom. These films serve as ground truth for three calculation methods: 1) Recalculation of the plan with shifted target point for every segment with the segment’s mean Calypso position. 2)+3) Convolution of the static dose distribution with a probability density function of the observed positions. For 2) only Calypso positions with activated beam on signal were used whereas for 3) all Calypso positions between the first and the last beam on signal for all fractions were employed. The comparisons between films and calculated dose distributions were made with the verification software VeriSoft 3.2 (PTW, Freiburg, Germany) where an 8x8 cm^2 ROI around the isocenter was selected for gamma evaluation.

Results: The segment shifted plans reach 3%/3mm gamma values above 90% against the films for all four patients. For both convolution methods three values are above 90%, only for the patient with the largest intrafraction motion they decrease to 89%.

Conclusions: Shifting of the target point for every segment is well suited to estimate the dosimetric consequences of intrafraction prostate motion. This may facilitate the evaluation of different margin sizes or dose prescribing recipes under different motion conditions. If such a lengthy calculation is not possible, a convolution with motion data can be used for acceptable results, too.

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