

AbstractID: 5304 Title: Patient specific differences in setup error variability and its effect on treatment margins in fractionated radiotherapy

Purpose:

It is often assumed that geometric error distributions in radiotherapy differ from patient to patient. It is however, problematic to substantiate this assumption because, generally, limited measurements are available per patient, giving a high uncertainty in the estimate of the standard deviation (SD). Our aim is to develop a simple method to estimate the true distribution variability based on statistical data analysis of a large patient population and to investigate the effect of detected variability on population based PTV-margins.

Method and Materials:

Setup error data of 470 prostate cancer patients (11 portal imaging measurements per patient, used for off-line corrections), were analyzed for random errors. The SD of the setup error was computed for each patient. The RMS-values of these numbers estimate the random uncertainty in the patient population. Next, the SD of the SD per patient is computed, containing the real distribution variability diluted by "measurement error in the SD" due to the limited number of samples. To estimate the true distribution variability, a correction is applied for this "measurement error". Finally, that margin was calculated that encloses the CTV with the 95% isodose for 90% of the population.

Results:

The true inter-patient variability is 26% of the SD, found after correcting for a "measurement error" of 18% (11 samples). Inter-patient distribution variability leads to larger PTV-margins, partly because the range of dose blurring becomes patient dependent. Assuming normality and the same SD variability in random and systematic errors, the margin for systematic errors increases from $2.5SD$ to $2.8SD$, maintaining the same margin for random errors.

Conclusion:

Inter-patient distribution variability exists but only slightly exceeds its measurement error and it is therefore difficult to detect for individual patients. By grouping many patients, it can be detected. A variable distribution requires slightly larger margins than a homogenous one.