

Purpose: To develop an intra-operative dose assessment procedure that can be performed after an I-125 prostate seed implantation, while the patient is still under anaesthesia. To accomplish this, we reconstruct the 3D position of each seed and co-register it with the prostate contour.

Method and materials: Our seed detection method involves a tomosynthesis-based filtered reconstruction of the volume of interest. For 24 patients, the required cone-beam images were obtained from 7 projections acquired over an angle of 60° with an isocentric imaging system adjacent to the treatment table. A graphical user interface (GUI) has been developed to allow visualization of the final seed positions and to interactively introduce corrections in the seeds positioning, if needed. The co-registration between the tomosynthesis-based seed positions and the TRUS-based prostate contour is performed by applying the same rigid transformation as the one derived from the best match between the planned and the reconstructed seed positions. Dose analysis is then performed based on the co-registered images.

Results: In a patient study with an average of 56 seeds per implant, the automatic tomosynthesis-based reconstruction yields a detection rate of 96% of the seeds and less than 1 false-positive seed per implant. The GUI allows the user to achieve a 100% detection rate in less than 5 minutes. The seed localization error obtained with a phantom study is (0.4 ± 0.4) mm. This leads to small dosimetric relative errors on D90 and V100 of respectively 1.5% and 0.3%. Patient dose analyses have shown a significant reduction in the dosimetric parameters between the planned and the post-operative dosimetry. The relative difference between planned and intra-operative D90 and V100 are respectively $(11 \pm 8)\%$ and $(4 \pm 3)\%$.

Conclusions: Our reconstruction method has the potential to provide accurate intra-operative prostate dosimetry, all in less than 10 minutes extra time added to the whole implantation procedure.