

## AbstractID: 7154 Title: An intra-operative dosimetry system for prostate brachytherapy using dual-modality imaging

**Purpose:** (1) To develop an intra-operative dose evaluation and optimization system for prostate brachytherapy using complementary imaging modalities (fluoroscopy for seed localization and ultrasound for prostate delineation). (2) To evaluate the usefulness of the intra-operative dosimetry system.

**Method and Materials:** Several algorithms were developed to realize the concept of fluoroscopy-ultrasound based dosimetry. These include automated seed detection, 3D seed reconstruction, patient motion correction, computer-assisted prostate contouring, and seeds-prostate registration algorithms. In order to accelerate the seed reconstruction from multiple x-ray projections, the dimensionality of seed matching process was reduced by strategically forming search restriction sub-images. Problems of incomplete data due to clustering and superposition of projected seeds were solved by a pseudo-matching technique. Patient movements between fluoroscopic image acquisitions were corrected through analysis of epipolar-planes. Registration of seeds and prostate volume was accomplished by establishing a sparse (small subset of seeds detected on ultrasound) to full (seeds reconstructed from fluoroscopy) data set correspondence.

**Results:** Intra-operative dosimetry was performed on 25 patients implanted with Pd-103 seeds. In nine patients, no additional seeds were implanted after intra-operative dose evaluation. In 16 patients, remedial seed were added based on the intra-operative evaluation. Subsequently, V100 values improved from  $86\pm 8\%$  to  $93\pm 4\%$  ( $p=0.005$ ). For all 25 patients, the post-implant dosimetry results using our system were compared with Day 0 CT-study. The V100 and D90 values from the fluoroscopy-ultrasound based dosimetry were  $95\pm 4\%$  and  $120\pm 24\%$  while the CT-based dosimetry computed  $95\pm 4\%$  and  $122\pm 24\%$ , respectively.

**Conclusion:** We have developed and implemented an intra-operative dosimetry system that combines the strengths of fluoroscopy and ultrasound. A clinical study has successfully demonstrated its intended utility in intra-operative setting by significantly improving the quality of seed implant in prostate brachytherapy.